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GRADUATE COLLEGE

THE EFFECT OF SELECTED LEARNER CHARACTERISTICS ON THE MODE OF PRESENTATION OF PAIRED-ASSOCIATE LEARNING TASKS

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THE EFFECT OF SELECTED LEARNER CHARACTERISTICS ON THE MODE OF PRESENTATION OF PAIRED-ASSOCIATE LEARNING TASKS

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TABLE OF CONTENTS

LIST OF TABLES vii

LIST OF FIGURES ix

Chapter

I. INTRODUCTION 1

Background for the Study
The Problem
The Purpose of this Study
The Paired-Associate Learning Task
Questions Answered by the Study
Hypotheses
Population
Outline of the Dissertation

II. A REVIEW OF SELECTED LITERATURE 12

Picture vs Words as Stimulus and Response Terms
Why may pictures be superior
Effect of Learner Characteristics
Other Studies of Measures of Ability as Related to the Mode of Presentation
Summary

III. PROCEDURE FOR THE EXPERIMENT 25

Preparation of the Instrument
Selection of stimulus terms
Selection of response terms
Making the slides
Equipment Used for the Experiment
Making Arrangements for the Experiment
Conducting the Experiment
Information on Characteristics of Subjects

IV. STATISTICAL ANALYSIS OF THE DATA 35

Analysis by Grades
Analysis by Sexes
Analysis by Reading Level
Analysis by Achievement Level

Chapter

V. CONCLUSIONS AND RECOMMENDATIONS 61

Findings
Conclusions
Recommendations

APPENDIX A 74

APPENDIX B 86

REFERENCES 95

LIST OF TABLES

Table		Page
1.	Means of Scores for Subjects Divided by Grade Level	37
2.	Analysis of Variance for Data Divided by Grades.	38
3.	Means for Grade Three Divided by Sex	40
4.	Analysis of Variance for Third Grade Divided by Sexes	41
5.	Means for Grade Eight Divided by Sexes	42
6.	Analysis of Variance for Eighth Grade Divided by Sexes	43
7.	Means for Grade Twelve Divided by Sexes	44
8.	Analysis of Variance for Twelfth Grade Divided by Sexes	44
9.	Means for Grade Three Divided by Reading Level..	46
10.	Analysis of Variance for Third Grade Divided by Reading Level	47
11.	Means for Grade Eight Divided by Reading Level..	48
12.	Analysis of Variance for Eighth Grade Divided by Reading Level	49
13.	Means for Grade Twelve Divided by Reading Level.	50
14.	Analysis of Variance for Twelfth Grade Divided by Reading Level	51
15.	Means for Grade Three Divided by Achievement Level	53
16.	Analysis of Variance for Third Grade Divided by Achievement	54

Table

17. Means for Grade Eight Divided by Achievement Level 55

18. Analysis of Variance for Eighth Grade Divided by Achievement 56

19. Means for Grade Twelve Divided by Achievement Level 57

20. Analysis of Variance for Twelfth Grade Divided by Achievement Level 58

21. Raw Data Used for Analysis of Variance by Grades 75

22. Raw Data on Grade Three Divided by Sexes 77

23. Raw Data on Grade Eight Divided by Sexes 78

24. Raw Data on Grade Twelve Divided by Sexes 79

25. Raw Data for Grade Three Divided by Reading Level 80

26. Raw Data for Grade Eight Divided by Reading Level 81

27. Raw Data for Grade Twelve Divided by Reading Level 82

28. Raw Data for Grade Three Divided by Achievement Level 83

29. Raw Data for Grade Eight Divided by Achievement Level 84

30. Raw Data for Grade Twelve Divided by Achievement Level 85

LIST OF ILLUSTRATIONS

Figure

1. Arrangements of Stimulus and Response Terms..... 28

THE EFFECT OF SELECTED LEARNER CHARACTERISTICS ON THE MODE OF PRESENTATION OF PAIRED-ASSOCIATE LEARNING TASKS

CHAPTER I

INTRODUCTION

Background for the Study

With the current emphasis on individualization of instruction came an interest in discovering how characteristics of the learner affect the design of media and the mode of presentation of materials to be learned. The Review of Educational Research for April 1968 reviewed the research on "Learner Variables and Educational Media". Although most of the research were related to programed learning, the author stated that we need "to consider learner characteristics while analyzing tasks with respect to the optimum kind of stimuli and learning conditions... which can be provided by various media."[1]

Mention was made in the literature of the "non-verbal" learner or "students of low verbal ability", which suggested

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[1]Leslie J. Briggs, "Learner Variables and Educational Media," Review of Educational Research, XXXVIII, No. 2, (April 1968), p. 172.

that some students may be able to learn more efficiently through pictures than through words.[2] These "non-verbal" students needed to be identified.

If a learner's cognitive style were based upon the condition of the learner at the time the stimulus was presented, then there was a possibility that one stimulus might be preferred by the organism over another stimulus. Learning is a subset of behavior, and behavior is a function of: (1) past experience and present expectations, (2) the present situation or the pattern of stimuli which impinge upon the subject, (3) inborn or innate capacity, and (4) other random effects.[3]

If the mode of presentation of the stimuli, whether verbal or pictorial, represented the pattern of stimuli which impinged upon the subject, change in behavior which may be attributed to this stimuli pattern also may be attributed to one or more of the three other functions listed above. Since under present conditions number four above was undefinable and thus untestable, this study depended upon: (1) past experience and present expectations, (2) inborn or innate capacities, or (3) upon

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[2]Ella C. Leppert and Victor M. Houston, "The Use of Audio-Visual Aids in the Instructional Program of the Secondary Schools," Teacher Education, IX, (December 1946), pp. 18-21.

[3]Note: from a class lecture in Education 420, by Dr. Don Reynolds, University of Oklahoma, Fall 1968.

some combination of these. The characteristics of the learner which were used in this study fell within these three categories.

The type of learning which was used in this study was paired-associate learning. Hilgard defined the paired-associated method as "That form of rote memorization in which items are learned in pairs, one item serving as the stimulus or cue for its to-be-associated item."[4] In this study the former was called the "stimulus term" while the latter was called the "response term".

A great deal of paired-associate learning is done in our schools in many different subject-matter areas. Learning of foreign languages, remembering dates, learning chemistry formulas, and the association of men with their contributions to society are some of the applications of paired-associate learning to instruction.

The use of a paired-associate learning task had several advantages in this study which included: (1) the use of pictures vs words as paired stimulus and response terms made it possible to test the effect of learner characteristics on two different modes of presentation; (2) it was more suitable for students with the wide age range of those in this study than a subject matter presentation would have been; (3) in this type of presentation it was possible

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[4] Ernest R. Hilgard, Introduction to Psychology, (New York: Harcourt Brace and Co., 1953), p. 603.

to gather data on the number of correct responses over several trials; (4) lack of knowledge of results after each response should not have been a factor since Brackett and Battig found equivalent performance under conditions of knowledge-of-results and no-knowledge-of-results in the use of paired-associate tests.[5]

The Problem

The problem of this study was to discover the effect of selected learner characteristics on the mode of presentation of paired-associate learning tasks. This involved the choice of grade level, sex, reading level, and achievement level as measured by the California Mental Maturity Test or its equivalent as the selected learner characteristics. It further involved use of two modes of presentation which were: (1) the pictorial mode which was a picture of an object as the stimulus term with a consonant-vowel-consonant (CVC) nonsense syllable as the response term presented simultaneously as paired-associates, and (2) the verbal mode which was a word naming an object as the stimulus term with a CVC nonsense syllable as the response term presented simultaneously as paired-associates.

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[5]William F. Battig, Analysis of Process in Paired-Associate Learning, Cooperative Research Projects, No. 730, (Charlottesville, Virginia, University of Virginia, 1962), pp. 11, 12.

The Purpose of This Study

The purpose of this study was to identify some of the characteristics of learners which have an effect upon the mode of presentation of materials which were to be learned through association in order that teachers may know which mode of presentation would offer the student the best opportunity for efficient learning. This was a step toward the discovery of ways to identify children who were non-verbal learners.

The Paired-Associate Learning Task

In the paired-associate learning task, items were learned in pairs. One item served as the stimulus term or cue for its to-be-associated item. In this study sixteen pairs of stimulus and response terms were shown to the subjects consecutively for a period of three seconds for each pair. Eight were pairs which represented the pictorial mode, and eight were pairs which represented the verbal mode. The pairs were arranged so that a pictorial mode pair was not followed by another pictorial mode pair. After the subjects had been shown the sixteen pairs of stimulus terms and response terms which were projected by a carousel slide projector on a screen for three second intervals, they were shown the sixteen stimulus terms without the responses, one at a time, for five seconds each and asked to write the nonsense syllable which was

the response term for that item. These also were arranged so that a pictorial stimulus term was not followed by another pictorial stimulus term.

Nonsense syllables were used as the response in an attempt to eliminate interference from previously learned associates for the words and pictures which were used as the stimulus terms for this study. Although nonsense syllables also have different degrees of difficulty, an attempt was made to choose nonsense syllables which had common difficulty. A more complete description of the procedure is in Chapter III.

Questions Answered By The Study

In order to determine the effects of the selected learner characteristics on the mode of presentation, an attempt was made to answer the following questions:

1. Did the learner's grade level effect the learning of paired-associates when they were presented by the pictorial mode versus the verbal mode?

2. Did the learner's sex effect the learning of paired-associates when they were presented by the pictorial mode versus the verbal mode?

3. Did the learner's reading level effect the learning of paired-associates when they were presented by the pictorial mode versus the verbal mode?

4. Did the learner's level of achievement, as

measured by the California Mental Maturity Test or its equivalent, effect the learning of paired-associates when they were presented by the pictorial mode versus the verbal mode?

Hypotheses

The four principal null hypotheses, each of which had three sub-hypotheses, which were tested in this study were:

1. There is no statistically significant difference between students at selected grade levels in the rate of learning of paired-associates when they are presented by the verbal mode versus the pictorial mode. This hypothesis is modified by the following sub-hypotheses:

1a. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates for students at the third grade level.

1b. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates for students at the eighth grade level.

1c. There is no statistically significant difference in the number of correct responses to a

verbal presentation vs a pictorial presentation of paired-associates for students at the twelfth grade level.

2. There is no statistically significant difference between students of opposite sex in the learning of paired-associates when they are presented by the verbal mode versus the pictorial mode. This second main hypothesis is modified by the following sub-hypotheses:

2a. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students of opposite sex at the third grade level.

2b. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students of opposite sex at the eighth grade level.

2c. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students of opposite sex at the twelfth grade level.

3. There is no statistically significant difference between students with different reading abilities in the learning of paired-associates when they are presented by

the verbal mode versus the pictorial mode. This third main hypothesis is modified by the following sub-hypotheses:

3a. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with higher or lower reading abilities at the third grade level.

3b. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with higher or lower reading abilities at the eighth grade level.

3c. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with higher or lower reading abilities at the twelfth grade level.

4. There is no statistically significant difference between students with different achievement levels as measured by the California Mental Maturity Test or its equivalent in the learning of paired-associates when they are presented by the verbal mode versus the pictorial mode. This fourth main hypothesis is modified by the following sub-hypotheses:

4a. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with low or normal, vs high achievement levels at the third grade level.

4b. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with low or normal vs high achievement levels at the eighth grade level.

4c. There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with low or normal, vs high achievement levels at the twelfth grade level.

Population

The population used in this study was students in the third, eighth, and twelfth grades from Jackson Park Elementary School, Hanley Junior High School, the University City Senior High School in University City, Missouri, and from Norman High School, Norman, Oklahoma. These students chosen by classes, at random, included eighty-five third grade

students, one hundred eighth grade students, and ninety-four twelfth grade students. Third grade subjects were selected by drawing one elementary school from the district and testing all third grade students in that school who were present on the test day. Eighth grade subjects were selected by drawing one section and testing all students in that section who were present on test day. Twelfth grade subjects were selected by drawing three twelfth grade English classes in University City High School and two psychology classes at Norman High School and testing all students in these classes who were present on the test day. Subjects who named the pictures for preparation of the instrument were selected by choosing every fifth child in an alphabetical listing of the children in the class.

Outline of the Dissertation

This dissertation was divided into five chapters as follows:

Chapter I. Statement of problem and background for the research.

Chapter II. A review of the literature.

Chapter III. A detailed description of the experiment.

Chapter IV. A statistical analysis of the data.

Chapter V. The summary of findings and recommendations.

References and appendix.

The next chapter reviews selected literature related to this study.

CHAPTER II

A REVIEW OF SELECTED LITERATURE

The present study was designed to discover the effect of selected learner characteristics on the mode of presentation of paired-associate learning tasks. In this chapter were placed descriptions of studies which have attempted to discover if individuals had different learning styles which might be characterized by their being able to learn more efficiently from one mode of presentation than from another. Concerning these individual differences in learners, Robert M. Gagne' wrote:

> The question of how people differ in the rate, extent, style, and quality of their learning is one which has concerned psychologists for a great many years. The history of investigation of this question is not characterized by smooth or continuous development. Instead, there have tended to be periods of activity followed by rather lengthy periods of inactivity... At the present time it seems fair to say that we know considerable more about learning, its varieties and conditions, than we did ten years ago. But we do not know much more about individual differences in learning than we did thirty years ago.[1]

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[1]Robert M. Gagne', ed., Learning and Individual Differences, A Symposium of the Learning Research and Development Center, University of Pittsburgh, (Columbus Ohio: Charles E. Merrill Books, Inc. 1967), p. xi.

Also placed in this chapter were those studies which dealt with use of pictures vs words as stimulus terms in paired-associate learning. Although some of these studies did not deal specifically with the effect of learner characteristics on the mode of presentation, they have a relationship to the design of the writer's study.

Picture VS Words as Stimulus and Response Terms

A study to determine which combination of stimulus terms and response terms best brought about paired-associate learning was done by A. A. Lumsdaine. He used four combinations of pictures and words as stimulus and response terms; picture-picture, picture-word, word-word, and word-picture. The first named was the stimulus term and the latter was the response term. He found, using seventy-two college students tested individually, one hundred-fifty college students tested in fifteen class groups, and three hundred eighth grade students tested in fifteen groups, that a picture was the better stimulus term, while the word was the better response term. The preferred order was, picture-word. After three trials the college group's scores tended to converge on the four modes of presentation, while the eighth grade students' scores tended to diverge.[2]

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[2]Arthur A. Lumsdaine, "Ease of Learning With Pictorial and Verbal Symbols," (unpublished Ph.D. dissertation, Stanford University, 1949).

As an incidental factor in his research, Lumsdaine grouped the subjects into equal-sized ability groups based on their achievement scores and their scores on the practice lists. His analysis showed no significant difference between these groups in the order of preference for the modes of presentation as represented by the number of correct responses. There was, however, a reversal in order for the word-word and the picture-word modes at the "poor" level. This difference was not statistically significant.[3]

Lumsdaine was unable to find any research related to the effectiveness of a pictorial vs a word presentation in paired-associate learning done previous to his study in 1949.[4] The only research in this area which was reported by N. L. Gage in 1963 was the study done by Lumsdaine and its replication by Kopsten in 1954 and Rachal in 1961 with the use of Russian-English vocabulary.[5]

In a review of "Learner Variables and Educational Media", Leslie J. Briggs stated, "For learners who can read, few generalizations can be made as to whether the

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[3] Ibid. pp. 128-132.

[4] Ibid. p. 8.

[5] N. L. Gage, Editor, Handbook of Research on Teaching, (Chicago: Rand McNally, 1963), p. 636.

instructional media should display pictures, sounds, spoken words, or printed words."[6] Most of the review was on learner variables as they applied to programed learning, however, a study by Cooper and Gaeth was reported which notes that "historically the data regarding the efficacy of auditory and visual materials have pointed to an interaction of modality with factors, notably intelligence, reading ability, age, and difficulty of materials." This study used subjects from grades four, five, six, ten and twelve with two tasks of different degrees of meaningfulness as represented by nonsense syllables and three letter nouns. The modes of presentation were visual and auditory. A significance of $p < .01$ was found for all three effects, grade, meaningfulness, and modality. The visual presentation was superior at grades four, five and six, while the same presentation was found inferior at grades ten and twelve.[7]

Joseph R. Jenkins and others in a paired-associate learning task used four modes: (1) sees pictures-recognizes pictures, (2) sees words-recognizes words, (3) sees words-recognizes pictures, and (4) sees pictures-recognizes

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[6]Leslie J. Briggs, "Learner Variables and Educational Media," Review of Educational Research, XXXVIII, No. 2, (April 1968), p. 166.

[7]Joseph R. Jenkins, Daniel C. Neale, and Stanley L. Deno, "Differential Memory for Picture and Word Stimuli," Journal of Educational Psychology, LVIII, No. 5, (1967), pp. 303-307.

words. Subjects were one hundred-twenty college sophomores assigned randomly to four groups. When the correct responses were compared, they found that the "sees pictures-recognizes pictures" group was superior to the "sees words-recognizes words" group ($p < .01$), while the "sees pictures-recognizes words" group was virtually the same as the "sees words-recognizes pictures" group. Both of these were significantly superior to the "sees words-recognizes words" group ($p < .025$).[8]

Why may pictures be superior? In an attempt to discover the contrasted psychological processes which might underlay the difference in the perception of pictorial and verbal stimuli modes, Stanley L. Deno studied the effects of pictures and words as stimuli in the learning of foreign language equivalents. Using seventy-two students, matched for sex, he experimented using twelve pairs of paired-associates. The paired-associates were either (1) an English word-Japanese word, or (2) a simple picture of an object-Japanese word for that object. He reported that picture and word representing the same familiar objects did not function as equivalent stimuli in the learning of a set of foreign language equivalents. Deno found that, generally, pictures facilitated learning,

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[8]Leslie J. Briggs, "Learner Variables...", pp. 166, 167.

especially when the objects representing abstractions were conceptually similar ($p < .005$). He concluded that pictures were probably not encoded in the same manner as words.[9]

Joseph R. Jenkins used a paired-associate learning task to determine if incidental cues in pictures, or different encoding strategy elicited by a picture caused picture stimuli to facilitate paired-associate learning in relation to word stimuli. He reported after using six separate treatments on seventy-two subjects that pictures produced faster learning when incidental cues were given for the pictures, but this faster learning did not take place when incidental cues were given for the words which were used as stimulus terms. Requiring Ss to label stimuli with a name, whether the stimulus term was a picture or a word, produced no significant difference. His findings of the superiority of the picture stimuli to the word stimuli replicated former studies.[10]

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[9]Stanley L. Deno, "Effects of Words and Pictures as Stimuli in Learning Language Equivalents," Journal of Educational Psychology, LIX, No. 3, (1968), pp. 202-206.

[10]Joseph R. Jenkins, "Effects of Incidental Cues and Encoding Strategies on Paired-Associate Learning," Journal of Educational Psychology, LIX, No. 6, (1968), pp. 410-413.

Some of the research which has been done in the area of the effectiveness of pictures as stimulus terms has attempted to relate this effectiveness to a conceptual peg hypothesis, that is, that pictures or more concrete objects have some associations already existing from the past experiences of the learner, therefore, offer more opportunity for the learner to use "pegs" to associate to the response term. Wimer and Lambert used real objects as the stimulus term and nonsense syllables as the response terms in an experiment. They found that nonsense syllables were learned with fewer trials as responses to objects than as responses to the printed name of the objects.[11]

Claims in support of the conceptual peg hypothesis were made by Allan Paivio and Dan Yarney. In a paired-associate learning task with a college psychology class, they found pictures were the better stimuli and words were the better responses.[12]

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[11]C. C. Wimar and W. E. Lambert, "The Differential Effects of Word and Object Stimuli on Learning of Paired-Associates," Journal of Experimental Psychology, LVII, (1959), pp. 31-36.

[12]Allan Paivio and A. Dan Yarney, "Pictures Versus Words as Stimuli and Responses in Paired-Associate Learning," Psychonomic Science, V, No. 6 (1966), pp. 235-236.

Effect of Learner Characteristics

Although these studies did not report any attempt to discover if individual characteristics of the learners had an effect upon their learning better with pictures as the stimuli than with words as stimuli, two studies reported attempts to establish that grade level and reading ability had an effect upon learning with pictures vs words. Wayne Otto and his associates at the Wisconsin Research and Development Center for Cognitive Learning reported a study using good and poor readers as variables in the learning of verbal and pictorial paired-associate lists. Subjects for the study were chosen from good and poor readers who attended second and fifth grades in a small city school system. The subjects were chosen who according to their teacher's judgements and the California Mental Maturity IQ scores were in the average intelligence range (90-115). Teacher's judgement and the Stanford Achievement Battery were used to divide these pupils into groups as either good or poor readers. They used a 2 x 2 x 2 factorial design with the independent variables being: A. second and fifth grades, B. good and poor reading ability, C. treatment by verbal or pictorial lists. A total of ninety-six subjects were used with six boys and six girls assigned to each of the cells in the factorial design.

Each subject was tested individually using pictures and words which named common objects. Number of errors to criterion of one errorless trial or twenty trials as a maximum was the individual's score. Analysis of variance of the scores revealed a significant F for grade, reading level, and for treatment effects. The means showed that good readers made fewer errors than did poor readers, and that fifth graders made fewer errors than did second graders. There were fewer errors by those students who were given pictorial lists than for those who were given verbal lists. The prediction that poor readers would do poorer than the good readers on the word lists but that there would be no difference with the pictorial lists was unfounded since the treatment by reading level interaction was not significant.[13]

The findings did not agree with the findings of Carin Cooper who used a list of pictures only for her paired-associate task and found no significant difference in the performance of good and poor readers.[14]

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[13]Wayne Otto, Karl Koenke, and Carin Cooper, "Good and Poor Readers' Learning of Verbal and Pictorial Paired-Associate Lists," Psychonomic Science, XI, No. 1 (1968), pp. 347-348.

[14]Carin Cooper, "The Relationships Among Reading Ability, Grade Level, and Syntactical Mediation in Paired-Associate Learning," (Unpublished Master's Thesis, University of Wisconsin, 1968).

In research done at the University of Minnesota, Robert E. Klen, and others studied the effects of sex and grade level on the learning of paired-associates using verbal and pictorial material. The paired-associate tasks consisted of six stimulus-response pairs. The concrete stimulus items consisted of concrete words and drawings of objects represented by concrete words, while the abstract stimulus items were represented by Japanese characters or abstract words. The response terms were nonsense syllables chosen from Archer's list of CVC trigrams within the range of 83-86 percent. The concrete terms resulted in a higher level of performance both as pictures and as words, the former being significant at the .01 level while the latter was significant at the .05 level on a one tailed test. Although the overall performance was lower at grade three than at grade five, the difference was significant only for concrete and abstract words. The difference between grades for the pictorial stimulus terms was not significant. At both grade levels, the girls made higher scores on the pictures and concrete words than did boys with concrete forms eliciting the highest overall performance. The fifth grade subjects made higher scores on the words, therefore, the report summarized that there "Appears to be a greater increase during this age period in the ability to differentiate verbal

than pictorial materials."[15]

William D. Rohwer, Jr. and others did an experiment to assess the facilitation of the acquisition of paired-associates using as subjects ninety-six third grade students and a like number of sixth grade students. Although the experiment was primarily designed to test the effect of different forms of verbalization as factors in the efficient learning of pictorial and verbal paired-associates, it also investigated the effect of grade level. The authors reported that the pictorial form of paired-associates was learned more efficiently with or without use of various sentence contexts and that "the detailed form of that relationship appears to depend upon the grade level of Ss and on the character of the learning materials."[16]

Other studies of measure of ability as related to the mode of presentation. A few studies have been done in an attempt to discover the relationship of some measures of ability to learning by various modes of presentation. Two studies which have been reported dealt with the use of

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[15]Robert E. Klen, Gordon A. Hale, Leon K. Miller, and Harold W. Stevenson, "Children's Paired-Associate Learning of Verbal and Pictorial Material," Psychonomic Science, IX, No. 4 (1967), pp. 203-204.

[16]William D. Rohwer, Jr., Steve Lynch, Joel R. Levin, and Nancy Suzuk, "Pictorial and Verbal Factors in the Efficient Learning of Paired-Associates," Journal of Educational Psychology, LVIII, No. 5 (1967), pp. 278-284.

motion pictures in learning. The effect of learner characteristics in learning from instructional films was studied by Richard Eric Snow. He used an introductory physics course taught at college level to compare filmed versus live presentation. Using a factorial design with fourteen variables, he found that the following seemed to favor the filmed presentation: (1) a favorable attitude toward instructional films, (2) little favorable attitude toward the subject matter to be presented, (3) low ascendancy, (4) high responsibility, (5) low numerical aptitude, (6) frequent past experiences with instructional films, and (7) frequent past experience with entertainment films. Each of these was modified by prior knowledge of the subject matter.[17]

Robert Radlow studied the relationship between some measures of ability and learning from sound motion pictures. He found that high verbal comprehension, general reasoning, and spatial orientation were characteristics of superior film learners. He recommended that training films should be used by trainees with high scores in verbal comprehension, general reasoning, and spatial orientation.[18]

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[17]Richard Eric Snow, Effect of Learner Characteristics in Learning from Instructional Films, (Unpublished Ph.D. dissertation, Stanford University, 1963).

[18]Robert Radlow, The Relation of Some Measures of Ability to Measures of Learning From Sound Motion Pictures, (Instructional Film Research Program, Pennsylvania State University, September 1955), ERIC ED002555.

Summary

Although some research has been reported in this chapter which found that pictures were better stimulus items in a paired-associate learning task than words, and some research has been reported which deals with the effects of learner characteristics on the mode of presentation of material to be learned, none has been reported which uses grade level, sex, reading ability and achievement as the selected characteristics to find their effects on the learning of paired-associates using pictorial and verbal stimulus terms. Several of the studies reported used nonsense syllables as the response terms. Lack of sufficient studies in this area show the need for further study as was done in the present experiment.

A description of the experiment is contained in the next chapter. This description described the instrument used, how it was prepared, and how the data for this study was gathered.

CHAPTER III

PROCEDURE FOR THE EXPERIMENT

Before proceeding with the experiment, an instrument to be used in the paired-associated test had to be prepared, and a step by step procedure for the administration of the test had to be outlined. Chapter III explains these steps in detail beginning with the preparation of the instrument to be used for the paired-associate test.

Preparation of the Instrument

None of the paired-associate instruments in the literature was available, therefore, an instrument was prepared which fitted the needs of the study. The instrument incorporated the two modes to be tested which were, (1)the pictorial mode with a picture as the stimulus term, and (2) the verbal mode with a word as the stimulus term. The pictures and words which served as the stimulus terms were selected along with the nonsense syllables which served as the response terms for both the pictorial mode and the verbal mode stimuli. The following procedure was followed in the selection of the stimulus and response terms for the paired-associate lists.

Selection of stimulus terms.--A large number of pictures of objects were cut from magazines, catalogues, newspapers, and books. Each of these objects could be named by a single noun. These pictures were shown to a random sample of five students chosen as described on page 11 from a third grade class at Madison Elementary School in Norman, Oklahoma. Each student was given the set of pictures and asked to name the object which they saw in each picture. A record was kept of their responses, and any picture which they could not name, or which was called by different names by different subjects, was withdrawn from the set. Ninety-six pictures of objects remained in the set after testing them with the third grade students. Only pictures which were readily identifiable by this sample of students were kept. Common nouns, used by these third grade students to name the objects in the pictures, were compared with the Gates' vocabulary list.[1] Words and accompanying pictures of objects the words named which were not at the third grade reading level or below according to this list were discarded.

Pictures and words were drawn at random from the remaining pictures and words, alternating a picture

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[1]Arthur I. Gates, Reading Vocabulary for the Primary Grades, (New York: Teachers College, Columbia University, 1926).

with a word, until eight of each mode had been drawn. No word which named a picture to be used in the test was kept, neither was any picture which was named by a word to be used in the test kept. A ninth word and picture were drawn from the sample to be used as an example in the introduction of the test.

Selection of response terms.--From Archer's list of nonsense syllables of the type CVC[2], nonsense syllables were selected at random and matched with each of the nine pictures and nine words. Nonsense syllables were selected from those which rated 50 on Archer's list. Words chosen were in the middle between those which had no meaning and those which had meaning for all of the subject in his experiment. These nonsense syllables should have caused less interference from previously learned associations than those syllables which were most meaningful, and yet the subjects should have been able to make some associations of the syllables with the stimulus terms.

Making the slides.--Each of the nonsense syllables and each of the words which were chosen to be used in the test instruments were formed from upper case cutout letters and pasted on technivellum. Through use of the

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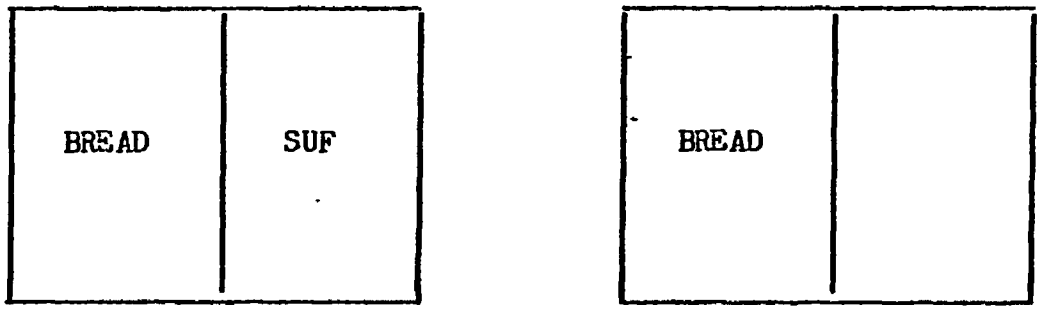
[2]E. J. Archer, "A Re-Evaluation of the Meaningfulness of All Possible CVC Trigrams," Psychological Monograms, 1960, 74 No. 497.

Diazo process, these words and nonsense syllables were placed on clear acetate in black letters.

Each of the nine pairs of each of the two modes of presentation, pictorial and verbal, was photographed on a 2 x 2 color slide with the stimulus term on the viewer's left and the response term on the viewer's right. Each stimulus term alone was photographed on a 2 x 2 color slide with a blank space on the right where the response term was formerly located. The ninth pair was the sample slide of each mode of presentation which was to be used as the example. Figure 1 illustrates how the stimulus and response terms were arranged on the slides.



Presentation slide Testing slide

Figure 1. Arrangement of stimulus and response terms.

Equipment Used for the Experiment

The equipment used in the experiment included a Kodak carousel slide projector with two trays, a Wollensak tape recorder, a programmer, the set of slides, and book-

lets of answer sheets for each child. An example of the answer booklet is included in the appendix.

Previous to beginning the experiment, signals were put on a magnetic tape which timed the showing of the sequence of pictures. The signals were timed to allow a three second showing of each stimulus term with its response term; a five second interval with the screen dark before beginning the showing of the stimulus terms alone; and a five second showing of each testing slide. The longer time period gave the students time to write on their test sheets the nonsense syllable which was the response term for each stimulus term. A twenty-five second interval was allowed between each of the five showings of the test. All five showings were timed by the magnetic tape through use of the above named equipment so there was uniformity in the presentation to all groups.

Making Arrangements for the Experiment

Arrangements were made with the school superintendent in University City, Missouri, and the school superintendent in Norman, Oklahoma, to do the experiment with students in their schools. Principals of the schools whose students were used in the tests were then contacted and final arrangements were made for classes to be tested and times scheduled for the experiment. The purpose of the experiment was explained to each teacher whose class was to be tested, and each gave his full cooperation.

Conducting the Experiment

All showings of the presentation and testing slides were conducted in semi-darkened classrooms. The slides were projected on a screen located at the front of the classroom. The size of the projection area varied slightly from group to group depending upon the size of the classroom, but was generally about 24 by 36 inches. There was enought light in the classroom to allow the students to see their answer sheets while they were writing response terms, but not enough to prevent their clearly viewing the slides on the screen. All equipment was prepared and ready for showing the learning tasks in the students' classroom before the testing period began.

At the beginning of the test period the class members were seated in their semi-darkened classroom. An answer booklet and a sharpened lead pencil were passed to each subject before the following directions were given:

> You are going to take what is called a paired-associate test. I will explain what that means in a few minutes. It is important that you do not watch what answers other students write on their papers. Your teacher will not see the results of this test. It will not be used for giving you grades. You should do the best you can, but do not worry if you cannot answer every time. This is a test to try to find out how people learn.
>
> Please write your name on the line beside the word "name". Be sure to write both your first and last names. (The subjects were allowed time to follow the directions.)
>
> Please write your grade number and your teacher's name on the blanks provided. (The subjects were allowed time to follow the directions.)

You are going to see a series of slides like this one. (The first sample slide containing the pictorial stimulus term along with the nonsense syllable response term was shown.)

Notice there is a picture on the left and a nonsense syllable on the right. The nonsense syllable is not a word but is just several letters. (The second sample slide containing the word stimulus term along with the nonsense syllable response was shown.)

Some of these slides have a word on the left instead of a picture. There is still a nonsense syllable on the right. (The sample test slide was shown with the picture on the left and the nonsense syllable on the right missing.)

Do you remember the nonsense syllable which was beside this picture the first time it was shown? If you do, write it on the answer sheet below where you wrote your grade number and beside the number one. If you do not remember the nonsense syllable, draw a line through the space beside the number one. (The sample test slide was shown with the word on the left and the nonsense syllable on the right missing.)

Do you remember the nonsense syllable which was beside this word the first time it was shown? If you do, write it on the answer sheet beside the number two. If you do not remember it draw a line through the space beside the number two. (Time was allowed for subjects to follow directions.)

Now you will be shown a series of sixteen slides. After you have seen them you will again be asked to write down the nonsense syllable which was beside the word or picture the first time you saw it. Turn over the first page of your answer booklet like this. Notice there are sheets for five "trys". You will have five different chances to answer correctly.

The experimenter showed how to turn over the first page of the answer booklet.

> Do not write on this answer sheet until you are told to do so. We are now ready to begin. Remember do not write until you are told to do so.

Each of the sixteen slides was shown for three seconds in the order given in the appendix with both stimulus terms and response terms being shown simultaneously on the same slide. After the series of sixteen slides had been shown the students were told:

> Write on the page which says "first try" the nonsense syllable which was beside the word or picture when you previously saw it. Remember to draw a line through the space beside the number if you do not remember the nonsense syllable...Begin.

Each of the sixteen test slides was shown for five seconds in the order shown in the appendix. After the test slides had been shown the students were told:

> Now turn over the sheet you just wrote on and get ready to view the slides again. Do not write in the spaces under "second try" until you are told to do so.

During the twenty-five second pause the slide tray was changed. The examiner said:

> Please watch the second showing of the slides.

After the second showing of the presentation slides was completed the subjects were told:

> Write on the page which says "second try" the nonsense syllable which was beside the word or picture when you previously saw it. Remember to draw a line through the space beside the number if you do not remember the nonsense syllable...Begin.

After the second showing of the test slides the students were told:

> Now turn over the sheet you just wrote on and get ready to view the slides again. Do not write in the spaces under "third try" until you are told to do so.

During the twenty-five second pause the slide tray was changed. The examiner said:

Please watch the third showing of the slides.

These same directions were given for the third, fourth and fifth trys with the only change being the number for the try.

After all five trys had been completed, the test booklets were passed to the front of the room and collected by the examiner. Later the test booklets were checked for correct answers. The number of correct answers for each mode, pictorial and verbal, was recorded.

Information on Characteristics of Subjects

Information on each subject's grade level, sex, reading level, and achievement level was copied from the school's permanent records.. The reading scores for third and eighth grade students were the latest available scores on the Iowa Test of Basic Skills. For twelfth grade students in the University City High School, the reading scores were from the California Reading Test, while for twelfth grade students in the Norman High School the reading scores were from the Sequential Tests of Educational

Progress (STEP). For all students except those from University City Senior High School, the achievement level recorded was the Intelligence Quotient on the California Mental Maturity Test. For the twelfth grade students in the University City Senior High School the scores recorded for achievement level were the intelligence quotient scores as measured by the Henmon-Nelson Test of Mental Ability.

The information of the learner characteristics, i.e., sex, grade level, reading ability, and achievement level, was recorded from the school's permanent records and later punched on Hollerith type IBM cards along with scores on each mode of presentation of the paired-associate learning task. The information about each subject was punched on a separate card along with the subject's name. The punching of data on cards made it possible to draw out all those who had the same sex, grade level, reading ability, or achievement level and compile statistics for each group separately.

Using the IBM 360 Statistical Package Program for finding analysis of variance, the data were processed on the IBM 360. The results of the statistical analysis of the data are contained in Chapter IV.

CHAPTER IV

STATISTICAL ANALYSIS OF THE DATA

After the data for the study were gathered as described in Chapter III, it was regrouped four times into sub-groups under the following categories in order to test the hypotheses stated in Chapter I:

1. by grade levels.
2. the third grade divided by sex.
3. the eighth grade divided by sex.
4. the twelfth grade divided by sex.
5. the third grade divided by reading levels.
6. the eighth grade divided by reading levels.
7. the twelfth grade divided by reading levels.
8. the third grade divided by achievement levels.
9. the eighth grade divided by achievement levels.
10. the twelfth grade divided by achievement levels.

The statistical techniques used to analyze the data from each of the above ten categories were a treatment by subject analysis of variance followed by a t test for difference between means. Two basic assumptions were made: (1) that the samples were randomly selected, and (2) that

the variance of the criterion measures were homogeneous.[1] The assumption that the samples were randomly selected was met through the selection of subjects as described in Chapter III. No tests were run on the homogeneity of variance but the Norton study suggested that unless the heterogenity of the variance is so enormous that it can be seen through an inspection of the data, the lack of homogeneity will have little effect on the F distribution.[2]

The IBM 360 computer was used to compute the analysis of variance on each set of data. The OS/360 Scientific Subrouting Package (SSP) based on the technique developed by H. O. Harley[3] permitted analysis of variance for a treatment x subjects design. The treatments x subjects design was used because the two modes of presentation were administered in sequence to the same subjects making possible the elimination of the influence of inter-subject differences upon the results.

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[1] E. F. Lindquist, Design and Analysis of Experiments in Psychology and Education, (Boston: Houghton Mifflin Company,,1956), p. 73.

[2] Ibid. p. 86.

[3] H. O. Hartley, Mathematical Methods of Digital Computers, Edited by A. Ralston and H. Wilf, (New York: John Wiley and Sons, 1962), Chapter 20.

Analysis by Grades

The first question to be answered in the study was: Did the learner's grade level effect the learning of paired-associates when they were presented by the pictorial mode versus the verbal mode? In order to answer this question, the subjects were divided into three groups according to grade level. Each of the groups representing grades three, eight and twelve was reduced to equal Ns through use of a random rejection of subject's data cards using a table of random numbers. The means for each of the groups for the different modes of presentation, pictorial and verbal, are shown in Table 1.

Table 1

MEANS OF SCORES FOR SUBJECTS DIVIDED BY GRADE LEVEL

GRADE	PICTURES	WORDS	MEAN
3	7.89	3.38	5.63
8	15.85	11.96	13.90
12	21.58	17.88	19.73
MEAN	15.11	11.07	13.09

Analysis of variance was performed on the data to test if the difference in the means was significant at the .05 level. The results are summarized in Table 2.

Table 2

ANALYSIS OF VARIANCE FOR DATA DIVIDED BY GRADES

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	Sig.
Mode	2112.64	1	2112.64	215.64	.001
Subject	8620.79	84	102.63		
Grade	17071.12	2	8535.56	85.18	.001
Mode x subj	823.69	84	9.81		
Mode x grade	14.73	2	7.36	.61	NS
Subj x grade	16833.69	168	100.20		
Mode x subj x grade	2030.82	168	12.09		
TOTAL	47507.48	509			

$F = {}^{ms}\text{modes} / {}^{ms}\text{modes x subjects}$ df. 1/84

$F = {}^{ms}\text{grades} / {}^{ms}\text{grades x subjects}$ df. 2/168

$F = {}^{ms}\text{modes x grades} / {}^{ms}\text{modes x subjects x grades}$ df. 2/168

The F ratio was computed here and throughout this chapter according to a method described by Lindquist.[4]

Table 2 showed a significant difference at the .001 level between the means for modes and for grades but no significant interaction between modes and grades. A t test was done to determine if the difference between the means for modes was significant at the 0.05 level for all three grades. The formula used to test the significance between means was:

$$t = \frac{M_{A_1} - M_{A_2}}{\text{est'd}\,\sigma_{(M_{A_1} - M_{A_2})}}$$

[4] E. F. Lindquist, Design and Analysis... pp. 237,238.

in which est'd $\sigma^2(M_{A_1} - M_{A_2})$ = MS error $(\frac{1}{n_1} + \frac{1}{n_2})$[5]. Throughout the chapter the formula used to test the difference between means was:

$$d = t\sqrt{\frac{2ms_{error}}{n}}.$$[6]

Since the degrees of freedom were 84 and 168 respectively, t was set at 1.96. The test of the significance between means for modes was $d = 1.96\sqrt{\frac{2(9.81)}{84}} = .946$. The difference between the means for grade three was 7.89-3.38= 4.51 with the first number being the mean for the pictorial mode. For grade eight the difference between the means was 15.85-11.96 = 3.89 with the first number being the mean for the pictorial mode. For grade twelve the difference between the means was 21.58 - 17.88 = 3.70 with the first number being the mean for the pictorial mode, therefore, the pictures were significantly better than words as stimulus terms at all three grade levels.

The formula used to test the differences between means for grades was $d = 1.96\sqrt{\frac{2(100.2)}{168}} = 2.136$. The difference between the means for grade eight and grade three was 13.90-5.63= 8.27. The difference between the means for grade twelve and grade three was 19.73-5.63 =14.10.

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[5] Ibid. p. 243.

[6] Ibid. p. 93.

while the difference between the means for grade twelve and grade eight was 19.73-13.90 = 5.83. Grade twelve students had significantly higher means at the .05 level than grade eight students, and both groups had significantly higher means than the grade three students.

Analysis of Students Divided by Sex

The second question to be answered in the study was: Did the learner's sex effect the learning of paired-associates when they were presented by the pictorial mode versus the verbal mode? To answer this question, the data were regrouped by sex at each of the three grade levels. In order to do an analysis of variance to determine if the difference in means was significant, it was necessary by random rejection of student's data cards to divide the sexes into equal Ns at each grade level. Table three shows the means for the third grade divided by sex:

Table 3

MEANS FOR GRADE THREE DIVIDED BY SEX

Sex	Pictures	Words	Mean
Female	8.8	3.625	6.212
Male	7.65	2.825	5.23
MEAN	8.225	3.225	5.725

Table 4 shows the analysis of variance summary for the third grade students divided by sex. This table showed a significant difference between modes at .001 level, but no significant difference between sexes, nor significant interaction between modes and sexes.

Table 4

ANALYSIS OF VARIANCE FOR THIRD GRADE DIVIDED BY SEXES

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	Sig.
Mode	878.91	1	878.91	87.80	.001
Subject	2090.49	39	53.60		
Sex	24.80	1	24.80	.54	NS
Mode x subj	380.34	39	10.01		
Mode x Sex	.76	1	.76	.12	NS
Subj x sex	1783.44	39	45.73		
Mode x sex x subj	246.49	39	6.32		
TOTAL	5415.23	159			

$F = {}^{ms}\text{modes} / {}^{ms}\text{modes x subjects}$ df. 1/39

$F = {}^{ms}\text{sex} / {}^{ms}\text{subjects x sex}$ df. 1/39

$F = {}^{ms}\text{modes x sex} / {}^{ms}\text{modes x sex x subjects}$ df. 1/39

The test of the significance between the means at the .05 level was $d = 1.96 \sqrt{\frac{2(10.01)}{39}} = 1.40$. The difference between means for females was 8.8-3.625 = 5.175 with the first number being the mean for the pictorial mode. For boys the difference was 7.650-2.825 = 4.825 with the first number being the mean for the pictorial mode. At the third

grade level pictures were better stimulus terms than words for both boys and girls at the .05 level of significance.

The means for grade eight divided by sexes are shown in Table 5.

Table 5

MEANS FOR GRADE EIGHT DIVIDED BY SEXES

Sex	Pictures	Words	Mean
Female	16.19	11.32	13.76
Male	14.70	11.72	13.21
MEAN	15.45	11.52	13.48

Table 6 shows the analysis of variance summary for the eighth grade students divided by sex. A significant difference between modes was shown at .001 level but no significant difference between sexes and only a .10 significance in the interaction between mode and sexes. The .10 level of significance in the interaction between means for modes and sexes was not considered significant, since the risk for a Type 1 error in this study was set to not exceed 5%.

The F for modes was significant at the .001 level of significance, therefore, a t test was performed to see if this difference was significant for both boys and girls at the eighth grade level.

Table 6

ANALYSIS OF VARIANCE FOR EIGHTH GRADE DIVIDED BY SEXES

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	Sig.
Mode	732.13	1	732.13	58.29	.001
Subject	7702.73	46	167.45		
Sex	14.94	1	14.94	.14	NS
Mode x subj	577.62	46	12.56		
Mode x sex	44.05	1	44.05	3.44	.10
Sex x subj	4931.79	46	107.21		
Mode x sex x subj	589.69	46	12.82		
TOTAL	14592.95	187			

$F = {}^{ms}\text{modes} / {}^{ms}\text{modes x subjects}$ df. 1/46

$F = {}^{ms}\text{sex} / {}^{ms}\text{sex x subjects}$ df. 1/46

$F = {}^{ms}\text{modes x sex} / {}^{ms}\text{modes x sex x subjects}$ df. 1/46

The test of the significance between the means for the modes was $d = 1.96 \sqrt{\frac{2(12.56)}{46}} = 1.45$. The difference between means for females was 16.19-11.32 = 4.87 with the first number being the mean for the pictorial mode. The difference between means for males was 14.70-11.72 = 2.98 with the first number being the mean for the pictorial mode. At the eighth grade level pictures as stimulus terms were better than words for both boys and girls at the .05 level of significance.

The means for grade twelve divided by sexes are shown in Table 7.

Table 7

MEANS FOR GRADE TWELVE DIVIDED BY SEXES

Sex	Pictures	Words	Mean
Female	21.51	18.77	20.14
Male	21.37	17.60	19.48
MEAN	21.44	18.18	19.81

Table 8

ANALYSIS OF VARIANCE FOR TWELFTH GRADE DIVIDED BY SEXES

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	Sig.
Mode	488.95	1	488.95	56.01	.001
Subjects	5229.23	42	124.50		
Sex	25.32	1	25.32	.27	NS
Mode x subj	366.55	42	8.73		
Mode x sex	16.95	1	16.95	1.27	NS
Subject x sex	5144.15	42	122.48		
Mode x subj x sex	560.55	42	13.35		
TOTAL	11831.70	171			

$F = {}^{ms}\text{modes} / {}^{ms}\text{modes x subjects}$ df 1/42

$F = {}^{ms}\text{sex} / \text{sex x subjects}$ df. 1/42

$F = {}^{ms}\text{modes x subjects} / {}^{ms}\text{modes x sex x subjects}$ df. 1/42

Table 8 shows the summary of analysis of variance for the twelfth grade students divided by sex. A signifi-

cant difference between modes was shown at .001 level, but no significant difference between sexes or in the interaction between mode and sexes. The test of the significance between the means at .05 level for the modes was $d = 1.96 \sqrt{\frac{2(8.73)}{42}} = 1.26$. The difference between means for females was 21.51-18.77 = 2.74 with the first number being the mean for the pictorial mode. The difference between means for males was 21.37-17.60 = 3.77 with the first number being the mean for the pictorial mode. At the twelfth grade level, pictures were better stimulus terms than words for both boys and girls at the .05 level of significance.

Analysis of Students Divided by Reading Level

The third question to be answered by the study was: Did the learner's reading level effect the learning of paired-associates when they were presented by the pictorial mode versus the verbal mode? In order to answer this question students at each of the three grade levels were divided into two groups according to reading level as shown by their latest Iowa Reading Test. Those who were at or below grade level at the time they took their test were put into the low group while those who were above grade level were put into the high group. It was necessary to randomly reject students' data cards through use of a table of random numbers in order to have

equal Ns for high and low reading levels at each of the three grade levels.

Table 9 shows the means of students at grade three, divided into a high and low reading group, for the two modes of presentation.

Table 9

MEANS FOR GRADE THREE DIVIDED BY READING LEVEL

Reading Level	Pictures	Words	Mean
Low	5.93	2.02	3.97
High	9.17	4.39	6.78
MEAN	7.55	3.20	5.37

Table 10 shows the summary of analysis of variance for the third grade students divided into a high and low reading group. This summary showed a significant difference between the modes of presentation at .001 level, and between the reading levels at .01 level, but no significant interaction between the mode and the reading level.

Table 10

ANALYSIS OF VARIANCE FOR THIRD GRADE DIVIDED BY READING LEVEL

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	Sig.
Mode	772.78	1	772.78	109.92	.001
Subject	1787.56	40	44.69		
Reading	322.56	1	322.56	8.02	.01
Mode x subject	281.22	40	7.03		
Mode x reading	7.90	1	7.90	1.25	NS
Subj x reading	1608.43	40	40.21		
Mode x subj x reading	252.09	40	6.30		
TOTAL	5032.54	163			

$F = {}^{ms}\text{modes} / {}^{ms}\text{modes x subjects}$ df. 1/40

$F = {}^{ms}\text{reading} / {}^{ms}\text{subjects x reading}$ df. 1/40

$F = {}^{ms}\text{modes x reading} / {}^{ms}\text{modes x reading x subjects}$ df. 1/40

The test of the significance between the means at the .05 level for the modes was $d = 1.96 \sqrt{\frac{2(7.03)}{41}} = 1.15$. The difference between means for the low reading level group was 5.93-2.02 = 3.01 with the first number being the mean for the pictorial mode. The difference between the means for the high reading level group was 9.17-4.39 = 4.78 with the first number being the mean for the pictorial mode. At the third grade level pictures were better stimulus terms than words for both high and low level readers at the .05 level of significance.

The test of the significance between means for the reading levels was $d = 1.96 \sqrt{\frac{2(40.21)}{41}} = 2.74$. The difference between means for the high group was 6.78-3.97 = 2.81 which showed that at the third grade level, the high reading group did better than the low reading group at the .05 level of significance.

Table 11 shows the means of students at grade eight, divided into a high and low reading group, for the two modes of presentation.

Table 11

MEANS FOR GRADE EIGHT DIVIDED BY READING LEVEL

Reading Level	Pictures	Words	Mean
Low	12.39	7.69	10.04
High	19.49	16.39	17.94
MEAN	15.94	12.04	13.99

The summary of the analysis of variance for the eighth grade students divided by reading level is shown in Table 12. It showed a significant difference between modes at .001 level, and between reading levels at .001 level, but no significant interaction between mode and reading level.

Table 12

ANALYSIS OF VARIANCE FOR EIGHTH GRADE

DIVIDED BY READING LEVEL

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	Sig.
Mode	744.51	1	744.51	94.36	.001
Subject	5075.97	48	105.74		
Reading	3056.51	1	3056.51	29.37	.001
Mode x subject	378.48	48	7.89		
Mode x reading	31.04	1	31.04	1.63	.25
Subject x read	4994.47	48	104.05		
Mode x subject x reading	914.95	48	19.06		
TOTAL	15195.93	195			

$F = {}^{ms}\text{modes} / {}^{ms}\text{modes x subjects}$ df. 1/48

$F = {}^{ms}\text{reading} / {}^{ms}\text{subjects x reading}$ df. 1/48

$F = {}^{ms}\text{modes x reading} / {}^{ms}\text{modes x subjects x reading}$ df. 1/48

The test for the significance of the difference between the means at the .05 level for the modes was $d = 1.96 \sqrt{\frac{2(7.89)}{49}} = 1.11$. The difference between the means for the low reading level group was 12.39-7.69 = 4.70 with the first number being the mean for the pictorial mode. The difference between the means for the high reading level group was 19.49-16.39 = 3.10 with the first number being the mean for the pictorial mode. At the eighth grade level both high and low reading level groups did significantly better at the .05 level when the pictorial mode of presentation was used.

A test of the significance of the difference between the high and low reading group was shown by $d = 1.96 \sqrt{\frac{2(104.05)}{49}} = 4.04$. This difference was tested by subtracting 17.94-10.04 = 7.90 which showed that the high reading group did significantly better at the .05 level than the low reading group on the paired-associate test at the eighth grade level.

The significance of the interaction between mode and reading level was not high enough to test with a *t* test.

Table 13 shows the means for students at grade twelve, divided into a high and low reading group, for the two modes of presentation.

Table 13

MEANS FOR GRADE TWELVE DIVIDED BY READING LEVEL

Reading Level	Pictures	Words	Mean
Low	20.00	14.37	17.18
High	21.89	19.97	20.93
MEAN	20.94	17.17	19.05

The summary of the analysis of variance for the twelfth grade divided by reading level is shown in Table 14. It showed a significant difference between modes at .001 level, and a significant interaction between modes and reading levels at .001 level. Although the difference

between means for reading levels was not significant at the .05 level a t test was performed on the difference between means to show which reading level group's means resulted in this lack of significance.

Table 14

ANALYSIS OF VARIANCE FOR TWELFTH GRADE DIVIDED BY READING LEVEL

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	Sig.
Mode	541.90	1	541.90	39.47	.001
Subject	3723.21	37	100.63		
Reading	534.37	1	534.38	4.06	.10
Mode x subject	507.85	37	13.73		
Mode x reading	130.80	1	130.80	14.32	.001
Subject x read	4864.35	37	131.47		
Mode x subject x reading	337.95	37	9.13		
TOTAL	10640.43	151			

$F = {}^{ms}\text{modes} / {}^{ms}\text{modes x subjects}$ df. 1/37

$F = {}^{ms}\text{reading} / {}^{ms}\text{subjects x reading}$ df. 1/37

$F = {}^{ms}\text{modes x reading} / {}^{ms}\text{modes x subjects x reading}$ df. 1/37

The test of the significance at the .05 level of the difference between the means for the modes was $d = 1.96 \sqrt{\frac{2(13.73)}{37}} = 1.68$. The difference between the means for the low reading level group was 20.00-14.37 = 5.63 with the first number being the mean for the pictorial presentation. The difference between means for the

high reading level group was 21.89-19.97 = 1.92 with the first number being the mean for the pictorial presentation. Both high and low groups did significantly better when the pictorial mode of presentation was used.

The test of the significance at the .05 level of the difference between the means for the high and low reading groups was $d = 1.96 \sqrt{\frac{2(131.47)}{37}} = 5.31$. The difference between the means was 20.93-17.18 = 3.75 showing no significance t between the two group means at the .05 level. However, the difference between high and low reading level groups on the verbal mode was 19.97-14.37 = 5.60 which was a significant difference at .05 level, while the difference between high and low reading level groups for pictorial mode was 21.89-20.00 = 1.89 which was not a significant difference at the .05 level.

The test of the significance of the interaction between the means for mode and reading level was $d = 1.96 \sqrt{\frac{2(9.13)}{37}} = 1.37$. The difference was tested by subtracting (20.00-14.37)-(21.89-19.97) = 3.71 which was significant at the .05 level.

Analysis of Students Divided by Achievement Level

The fourth question to be answered by the study was: Did the learner's level of achievement, as measured by the California Mental Maturity Test or its equivalent, effect the learning of paired-associates when they were

presented by the pictorial mode versus the verbal mode? In order to answer this question students at each of the three grade levels were divided into two groups according to achievement level as shown by an IQ score on the California Mental Maturity Test or the Henmon-Nelson Test of Mental Ability. They were divided into two groups at each grade level with the low group being those with an IQ score of 110 or less and the high group being those students with an IQ score greater than 110. It was necessary to randomly reject student's data cards containing their score through use of a table of random numbers in order to have equal Ns for high and low achievement groups at each of the three grade levels.

Table 15 shows the means for students at grade three, divided into high and low achievement groups, for the two modes of presentation.

Table 15

MEANS FOR GRADE THREE DIVIDED BY ACHIEVEMENT LEVEL

Achievement Level	Pictures	Words	Mean
110 or below	6.48	2.34	4.41
Above 110	8.55	3.55	6.05
MEAN	7.51	2.94	5.23

The summary of the analysis of variance for the third grade students divided by achievement level is shown in

Table 16. This table showed a significant difference at the .001 level between the means for modes but no significant difference between the means for achievement levels, and no significant interaction between the means for modes and achievement levels.

Table 16

ANALYSIS OF VARIANCE FOR THIRD GRADE DIVIDED BY ACHIEVEMENT

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	Sig.
Mode	605.39	1	605.39	99.24	.001
Subject	827.96	28	29.57		
Achievement Level	77.80	1	77.80	2.12	NS
Mode x subject	170.86	28	6.10		
Mode x Achievem	5.39	1	5.39	.65	NS
Subject x Achiev	1029.45	28	36.76		
Mode x subject x achievement	231.86	28	8.28		
TOTAL	2948.71	115			

$F = {}^{ms}\text{modes} / {}^{ms}\text{modes x subjects}$ df. 1/28

$F = {}^{ms}\text{achievement} / {}^{ms}\text{achievement x subjects}$ df. 1/28

$F = {}^{ms}\text{modes x achievement} / {}^{ms}\text{modes x achievement x subjects}$ df. 1/28

Since the degrees of freedom for the t test was 28, the test for significant difference at the .05 level between the means for modes was $d = 2.05 \sqrt{\frac{2(6.10)}{28}} = 1.35$. The difference between the means for the low achievement group was 6.48-2.34 = 4.14 with the pictorial mode being the first score. The difference between the means for the

means for the high achievement group was 8.55-3.55 = 5.00 with the pictorial mode being the first score. At the third grade level both high and low achievement level groups did significantly better at .05 level when the pictorial mode of presentation was used.

Table 17 shows the means for students at grade eight, divided into high and low achievement groups, for the two modes of presentation.

Table 17

MEANS FOR GRADE EIGHT DIVIDED BY ACHIEVEMENT LEVEL

Achievement Level	Pictures	Words	Mean
110 or below	11.91	8.04	9.97
Above 110	20.73	16.58	18.65
MEAN	16.32	12.31	14.31

The summary of the analysis of variance for the eighth grade students divided by achievement level is shown in Table 18. This table showed a significant difference between the means for modes and between the means for modes and achievement levels.

Table 18

ANALYSIS OF VARIANCE FOR EIGHTH GRADE DIVIDED BY ACHIEVEMENT

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	Sig.
Mode	724.01	1	724.01	50.17	.001
Subject	4942.68	44	112.33		
Achievement	3388.67	1	3388.67	44.83	.001
Mode x subject	634.74	44	14.43		
Mode x achieve	.94	1	.94	.07	NS
Subj x achieve	3326.06	44	75.59		
Mode x subj x achievement	555.81	44	12.63		
TOTAL	13572.91	179		.	

$F = {}^{ms}\text{modes} / {}^{ms}\text{modes x subjects}$ df. 1/44

$F = {}^{ms}\text{achievement} / {}^{ms}\text{achievement x subjects}$ df. 1/44

$F = {}^{ms}\text{achievement x modes} / {}^{ms}\text{achievement x modes x subjects}$ df. 1/44

Since the degrees of freedom for the t test was 44 the test of significant difference at the .05 level between the means for the modes was $d = 1.96\sqrt{\frac{2(14.43)}{44}} = 1.58$. The difference between the means for the low achievement group was 11.91-8.04 = 3.87. The difference between the means for the high achievement group was 20.73-16.58 = 4.15 with the pictorial mode being the first score in each equation. At the eighth grade level both high and low achievement level groups did significantly better at .05 level when the pictorial mode of presentation was used.

The test of the significance of the difference between the means for the high and low achievement levels was $d = 1.96 \sqrt{\frac{2(75.59)}{44}} = 3.63$. The difference between the means was 18.65-9.97 = 8.68, which showed that at eighth grade level the high achievement group did better than the low achievement group at the .05 level of significance.

Table 19 shows the means for students at grade twelve, divided into high and low achievement groups, for two modes of presentation.

Table 19.

MEANS FOR GRADE TWELVE DIVIDED BY ACHIEVEMENT LEVEL

Achievement Level	Pictures	Words	Mean
110 or below	20.14	14.19	17.16
Above 110	21.14	18.62	19.88
MEAN	20.64	16.40	18.52

The summary of the analysis of variance for the twelfth grade students by achievement level is shown in Table 20. This table showed a significant difference at the .001 level between the means for modes and a significant interaction at .05 level between the modes and achievement levels, but did not show a significant difference between achievement levels.

Table 20

ANALYSIS OF VARIANCE FOR TWELFTH GRADE DIVIDED BY ACHIEVEMENT LEVEL

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F	Sig.
Mode	377.19	1	377.19	28.53	.001
Subject	2985.45	20	149.27		
Achievement	154.71	1	154.71	2.71	NS
Mode x subject	264.31	20	13.22		
Mode x achieve	61.71	1	61.71	5.51	.05
Subject x achie	1139.79	20	56.99		
Mode x subj x achievement	223.79	20	11.19		
TOTAL	5206.95	83			

$F = {}^{ms}\text{mode} / {}^{ms}\text{mode x subjects}$ df. 1/20

$F = {}^{ms}\text{achievement} / {}^{ms}\text{subjects x achievement}$ df. 1/20

$F = {}^{ms}\text{mode x achievement} / {}^{ms}\text{mode x achievement x subjects}$ df. 1/20

The degrees of freedom for the t test was 20, therefore, the test of significant difference at the .05 level between the means for the modes was computed $d = 2.09 \sqrt{\frac{2(13.22)}{20}} = 3.40$. The difference between the means for the low achievement group was 20.14-14.19 = 5.95 with the first score being that for the pictorial mode of presentation. The difference between the means for the high achievement group was 21.14-18.62 = 2.52 with the first score being that for the pictorial mode of presen-

tation. At the twelfth grade level the mean for the pictorial mode was significantly higher than the mean for the verbal mode for the low achievement group, but not significantly higher for the high achievement group at the .05 level of significance.

The test of the significance of the interaction between the means for the mode and achievement level was $d = 2.09 \sqrt{\frac{2(11.19)}{20}} = 2.22$. The difference between means was tested by subtracting (20.14-14.19)-(21.14-18.62) = 3.43. The interaction between the means for the mode and achievement level was significant at the .05 level.

Summary

Analysis of the data showed a significant difference in favor of the pictorial presentation for all groupings of the data with the exception of the high level of achievement group at grade twelve. The high level of achievement group at grade twelve showed no significant difference in the means of the pictorial and verbal presentations of the paired-associate test.

Significantly higher means on the paired-associate test were made by the twelfth grade than those of the eighth grade, both of which were higher than the means of the third grade. There was no statistically significant difference between the means of scores between sexes. The high reading level group was statistically superior

to the low reading group at grades three and eight but not at grade twelve. The high achievement level did statistically superior to the low achievement level group at the third and eighth grade, but not at the twelfth grade level.

The only statistically significant interaction was between modes and reading, and between modes and achievement at the twelfth grade level. A slight interaction was found between mode and sex and between mode and reading level at the eighth grade, but it was not statistically significant at the .05 level.

Conclusions and recommendations are in Chapter V.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The problem of this study was to discover the effect of selected learner characteristics on the mode of presentation of paired-associate learning tasks. The two modes of presentation were the pictorial mode and the verbal mode, while the selected learner characteristics were grade level, sex, reading level, and achievement level as defined in the study. Four main hypotheses were set up, each having three sub-hypotheses, to test the effect of the selected learner characteristics on the mode of presentation. The following section contains the findings for each of the hypotheses.

Findings

Hypothesis 1. stated: There is no statistically significant difference between students at selected grade levels in the rate of learning of paired-associates when they are presented by the verbal mode versus the pictorial mode.

Hypothesis 1a. stated: There is no statistically significant difference in the number of correct

responses to a verbal presentation vs a pictorial presentation of paired-associates for students at the third grade level.

Hypothesis 1b. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates for students at the eighth grade level.

Hypothesis 1c. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates for students at the twelfth grade level.

The statistical treatment of the data in Chapter IV showed that subjects at third, eighth, and twelfth grade levels in the sample distribution had a statistically significant difference between means which was higher for the pictorial mode than for the verbal mode. Therefore, hypothesis 1a, that there was no statistical difference in the number of correct responses to a verbal vs a pictorial presentation at the third grade level was rejected at the .05 level of significance. The hypothesis 1b, that there was no statistical difference in the number of correct responses to a verbal vs a pictorial presentation at the eighth grade level was rejected at the .05 level of significance, and hypothesis 1c, that there was no statistical

difference in the number of correct responses to a verbal vs a pictorial presentation at the twelfth grade level was rejected at the .05 level of significance.

However, since the interaction between the means for grade level and mode was not statistically significant and did not show that subjects at one grade level could learn better from the pictorial mode while subjects at another grade level could learn just as well as or better from the verbal mode of presentation, the main hypothesis 1 was accepted.

The hypothesis that grade level does not make a significant difference between the learning by the two modes of presentation was accepted because the subjects at all grade levels learned significantly better through use of the pictorial mode of presentation. Grade level did not effect the mode of presentation of the paired-associate learning task for the subjects in the author's study. Lack of interaction between the mode and grade level suggested that for students like the ones in the sample used for this study, grade level did not effect whether one can learn more efficiently from a pictorial presentation rather than from a verbal presentation of paired-associate learning tasks.

Hypothesis 2. stated: There is no statistically significant difference between students of opposite sex in the learning of paired-associates when

they are presented by the verbal mode versus the pictorial mode.

Hypothesis 2a. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students of opposite sex at the third grade level.

Hypothesis 2b. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students of opposite sex at the eighth grade level.

Hypothesis 2c. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students of opposite sex at the twelfth grade level.

The statistical treatment of the data in Chapter IV showed that subjects of both sexes at the third, eighth, and twelfth grade levels had a statistically higher mean for the scores for the pictorial mode than for the verbal mode. Therefore, sex did not effect the mode of presentation at any of the three grade levels. The means for

girls on the total scores was not statistically different from that of the boys.

Hypothesis 2a, that there was no statistical difference in the number of correct responses to a verbal vs a pictorial presentation of paired-associates between sexes at the third grade was accepted. Hypothesis 2b, that there was no statistical difference in the number of correct responses to a verbal vs a pictorial presentation of paired-associates between sexes at the eighth grade was accepted. Hypothesis 2c, that there was no statistical difference in the number of correct responses to a verbal vs a pictorial presentation of paired-associates between sexes at the twelfth grade was accepted. Lack of interaction between the mode of presentation and sex suggested that for students like the ones in the sample, sex differences did not effect whether one can learn more efficiently from a pictorial presentation rather than from a verbal presentation of paired-associates. Both sexes learned more efficiently through use of the pictorial mode at all three grade levels, therefore, main hypothesis 2 was accepted.

Hypothesis 3. stated: There is no statistically significant difference between students with different reading abilities in the learning of paired-associates when they are presented by the verbal mode versus the pictorial mode.

Hypothesis 3a. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with higher or lower reading abilities at the third grade level.

Hypothesis 3b. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with higher or lower reading abilities at the eighth grade level.

Hypothesis 3c. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with higher or lower reading abilities at the twelfth grade level.

The statistical treatment of the data in Chapter IV showed that subjects in the sample distribution had a statistically significant difference between means which was higher for the pictorial mode than for the verbal mode at both reading levels used in this study. The statistical significance at the .05 level was found at third, eighth, and twelfth grades. The high reading level group had significantly higher means than the low reading level group

in grades three and eight, but not at grade twelve. No significant interaction between the mode of presentation and reading level was found at grades three or eight to suggest that for students like the ones in the sample population, reading level effected whether one can learn more efficiently from a pictorial rather than a verbal presentation of a paired-associate learning task. therefore, hypothesis 3a, that there was no statistically significant difference in the number of correct responses to a verbal vs a pictorial presentation of paired-associates between reading levels at the third grade was accepted. Hypothesis 3b, that there was no statistically significant difference in the number of correct responses to a verbal vs a pictorial presentation of paired-associates between reading levels at the eighth grade was accepted. The subjects in the sample learned better from the pictorial mode no matter what their level of reading was at grades three and eight.

However, a significant interaction between the mode of presentation and reading level for students at grade twelve suggested that for subjects like the ones in the sample, those with the better reading abilities can learn just as well from either pictorial or verbal presentations of paired-associates, while those with poorer reading abilities can learn better from a pictorial presentation.

Hypothesis 3c, that there was no statistically significant difference in the number of correct responses to a verbal vs a pictorial presentation of paired-associates between reading levels at the twelfth grade was rejected. The subjects in the sample learned by the pictorial mode more efficiently if they were in the poorer reading group, while the subjects in the sample from the higher reading level group did not learn significantly better by one mode than by the other.

Main hypothesis 3 was rejected when hypothesis 3c was rejected because of the statistically significant interaction between mode of presentation and reading ability at the twelfth grade level. Interaction between mode and reading made it necessary to reject or modify the third main hypothesis.

Hypothesis 4. stated: There is no statistically significant difference between students with different achievement levels as measured by the California Mental Maturity Test or its equivalent in the learning of paired-associates when they are presented by the verbal mode versus the pictorial mode.

Hypothesis 4a. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates

between students with low or normal, vs high achievement levels at the third grade level.

Hypothesis 4b. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with low or normal, vs high achievement levels at the eighth grade level.

Hypothesis 4c. stated: There is no statistically significant difference in the number of correct responses to a verbal presentation vs a pictorial presentation of paired-associates between students with low or normal, vs high achievement levels at the twelfth grade level.

The statistical treatment of the data in Chapter IV showed that subjects at the third, eighth, and twelfth grades in the sample distribution had a statistically significant difference in means at the .05 level which was higher for the pictorial mode than for the verbal mode with one exception. That exception was the high achievement level group at grade twelve. The high achievement group at grade twelve showed no significant difference between the means of the scores on the two modes of presentation.

Lack of interaction between the mode of presentation and achievement level at grades three and eight suggested

that for subjects like the ones in the sample population, achievement does not effect whether one can learn more efficiently from a pictorial presentation rather than a verbal presentation. Both high and low achievers learned better from the pictorial presentation. Hypothesis 4a, that there was no statistically significant difference at the .05 level in the number of correct responses to a verbal vs a pictorial presentation of paired-associates between achievement levels at the third grade was accepted. Hypothesis 4b, that there was no statistically significant difference at the .05 level in the number of correct responses to a verbal vs a pictorial presentation of paired-associates between achievement levels at the eighth grade was accepted.

The statistically significant interaction at the .05 level between mode of presentation and achievement level at grade twelve suggested that for subjects similar to the ones in the sample, achievement does have an effect upon whether one can learn more efficiently from a pictorial presentation of paired-associates rather than a verbal presentation. The low achievement level group learned better through the pictorial stimulus, while the high achievement level group learned as efficiently by one mode as by the other. Therefore, hypothesis 4c, that there was no statistically significant difference in the number

of correct responses to a verbal vs a pictorial presentation of paired-associates between achievement levels at the twelfth grade was rejected.

Main hypothesis 4 was rejected when hypothesis 4c was rejected because of the statistically significant interaction between mode of presentation and achievement level at the twelfth grade level. Interaction between mode and achievement level made it necessary to reject or modify the fourth main hypothesis.

The statistically significant higher scores on the pictorial mode of presentation, which used pictures as the stimulus term, in a paired-associate learning task for all groups with the exception of the high reading group and the high achievement group at twelfth grade confirms the findings of Lumsdaine, Kopsten, Rachal, Jenkins, Paivio, and others described in Chapter II of the author's study. The effect of grade level as studied by Klen and Rohwer showed that grade level of itself did not seem to be a determining factor in the learning of paired-associates by the two different modes, but rather that the interaction of reading level with mode at a certain grade level, namely twelfth, had an effect upon the mode of presentation, and the interaction of achievement level with mode at a certain grade level, namely twelfth, had an effect upon the mode of presentation.

The significant difference between high and low

reading groups at third and eighth grades confirms the findings of Otto and his associates. They also failed to find any interaction between reading level and the mode of presentation.

Conclusions

Although this experiment confirmed the superiority of pictures as stimulus terms in paired-associate learning tasks for most subjects, it showed that some students can learn as well by the verbal mode of presentation as by the pictorial mode of presentation in paired-associate learning. In the present study, twelfth grade students who were in the high reading group, or in the high achievement group showed no significant difference in their learning of paired-associates by the two different modes of presentation. Since the problem of this study was to discover the effect of selected learner characteristics on the mode of presentation of paired-associate learning tasks, it may be concluded that for the learner characteristics chosen for this study only reading level and achievement level in the twelfth grade effected mode of presentation. All other groups of subjects learned better from the pictorial mode.

Recommendations

In view of the results reported in the present study,

the following recommendations were made:

1. For students in a middle class suburban community similar to the ones in this study, it is recommended that paired-associate learning tasks should be taught using pictures as the stimulus mode whenever possible.

2. For twelfth grade students in a middle class suburban community similar to the ones in this study, it is recommended that high reading level students be taught using either pictures or words as the stimulus mode for paired-associate learning tasks.

3. For twelfth grade students in a middle class suburban community similar to the ones in this study, it is recommended that high achievement level students be taught using either pictures or words as the stimulus mode for paired-associate learning tasks.

Recommendations for further study: (1) Further study might prove fruitful using color as one of the factors in determining if learner characteristics effect the mode of presentation of paired-associate learning tasks. (2) Further study using other learner characteristics such as ability as measured by the Stanford-Binet and social class might be worthwhile.

APPENDIX A

Table 21

RAW DATA USED FOR ANALYSIS OF VARIANCE BY GRADES

Pupil #	Grade Three		Grade Eight		Grade Twelve	
	Pictures	Words	Pictures	Words	Pictures	Words
1	2	1	14	5	14	3
2	25	20	7	8	11	4
3	2	0	35	25	12	14
4	4	6	13	6	19	21
5	3	0	6	6	23	20
6	5	0	14	5	28	30
7	1	5	33	28	21	20
8	3	0	23	14	34	29
9	2	2	9	5	3	0
10	14	2	16	19	21	19
11	2	1	1	0	21	16
12	22	8	4	7	20	20
13	24	11	25	17	14	13
14	14	7	16	18	20	23
15	14	6	26	16	18	19
16	11	6	17	15	15	18
17	9	1	2	3	25	8
18	8	8	25	23	33	30
19	7	2	11	10	16	12
20	8	2	29	26	23	19
21	7	2	11	7	28	30
22	2	2	3	3	33	29
23	1	0	25	26	27	16
24	3	0	22	14	32	27
25	16	7	27	19	21	11
26	17	14	21	5	17	20
27	8	0	12	12	15	14
28	13	2	9	1	18	15
29	2	0	11	9	22	18
30	8	8	33	17	13	15
31	9	1	4	8	28	22
32	4	0	5	1	29	26
33	5	7	13	4	18	16
34	10	0	11	5	14	11
35	0	1	14	10	12	8
36	2	1	15	12	25	5
37	4	3	5	1	14	10
38	9	3	14	15	13	6
39	1	1	5	2	28	24
40	0	1	6	6	25	25
41	10	3	24	9	26	22
42	14	7	10	12	7	0
43	23	12	14	2	25	18
44	7	3	24	28	30	15

RAW DATA USED FOR ANALYSIS OF VARIANCE BY GRADES

Pupil #	Grade Three		Grade Eight		Grade Twelve	
	Pictures	Words	Pictures	Words	Pictures	Words
45	2	0	21	18	34	25
46	11	2	8	5	18	11
47	1	2	28	20	29	26
48	13	2	25	14	15	13
49	10	0	16	4	21	21
50	7	5	23	15	22	20
51	25	9	10	7	23	22
52	3	2	16	16	14	15
53	5	1	21	25	35	34
54	1	0	28	16	5	2
55	4	0	6	4	22	12
56	4	2	16	15	19	17
57	12	3	25	24	28	26
58	6	4	24	10	23	23
59	7	0	0	1	29	24
60	6	0	21	7	22	23
61	14	5	11	5	32	29
62	4	0	22	24	13	12
63	4	1	37	29	14	9
64	29	19	26	19	33	33
65	5	5	16	10	26	24
66	6	2	17	10	23	19
67	4	3	22	18	25	2
68	3	0	11	6	20	13
69	5	5	18	22	26	30
70	10	3	13	13	7	6
71	9	4	25	17	27	21
72	19	9	23	14	19	14
73	6	3	15	12	30	28
74	8	4	3	1	11	9
75	5	3	9	14	11	8
76	6	0	1	3	15	8
77	9	2	15	9	22	9
78	5	3	11	6	32	28
79	18	13	20	28	10	10
80	3	0	20	23	18	13
81	6	4	3	1	27	23
82	4	1	6	2	30	25
83	5	0	32	28	32	25
84	7	0	26	16	26	30
85	5	0	3	2	35	37

Table 22

RAW DATA ON GRADE THREE DIVIDED BY SEXES

Girls			Boys		
Pupil #	Pictures	Words	Pupil #	Pictures	Words
1	5	3	1	5	5
2	6	3	2	25	20
3	10	3	3	2	1
4	5	5	4	3	0
5	3	0	5	2	0
6	29	19	6	2	2
7	4	0	7	14	2
8	14	5	8	22	8
9	6	0	9	7	2
10	7	0	10	2	2
11	6	4	11	16	7
12	4	0	12	8	0
13	5	1	13	2	0
14	7	5	14	8	8
15	7	3	15	4	0
16	23	12	16	3	0
17	14	7	17	4	1
18	0	1	18	5	0
19	1	1	19	5	0
20	0	1	20	9	2
21	10	0	21	6	0
22	5	7	22	5	3
23	9	1	23	19	9
24	13	2	24	9	4
25	3	0	25	4	3
26	1	0	26	6	2
27	7	2	27	4	1
28	8	8	28	12	3
29	9	1	29	4	2
30	11	6	30	1	0
31	14	6	31	25	9
32	14	7	32	10	0
33	24	11	33	13	2
34	1	5	34	1	2
35	3	0	35	11	2
36	5	0	36	2	0
37	18	13	37	10	3
38	6	4	38	9	3
39	8	4	39	4	3
40	7	0	40	3	2

Table 23

RAW DATA ON GRADE EIGHT DIVIDED BY SEXES

Girls			Boys		
Pupil #	Pictures	Words	Pupil #	Pictures	Words
1	11	5	1	6	6
2	21	7	2	15	12
3	24	10	3	25	26
4	25	24	4	11	7
5	23	15	5	11	10
6	8	5	6	2	3
7	5	1	7	10	18
8	19	11	8	16	18
9	14	10	9	25	17
10	16	10	10	14	5
11	13	4	11	13	6
12	32	28	12	4	7
13	11	5	13	29	26
14	17	10	14	5	2
15	11	6	15	20	23
16	18	22	16	12	12
17	13	13	17	15	13
18	9	14	18	11	9
19	11	6	19	5	1
20	3	1	20	4	8
21	6	2	21	14	15
22	32	28	22	24	9
23	26	16	23	14	2
24	17	5	24	8	8
25	22	24	25	21	18
26	21	5	26	8	5
27	2	0	27	28	20
28	3	3	28	16	4
29	11	1	29	10	7
30	25	23	30	29	29
31	26	16	31	21	25
32	1	0	32	6	4
33	16	19	33	11	9
34	9	5	34	0	1
35	23	14	35	19	11
36	33	28	36	15	9
37	6	6	37	3	1
38	35	25	38	1	3
39	7	8	39	23	14
40	17	15	40	15	12
41	22	14	41	25	17
42	9	1	42	22	18
43	24	28	43	37	29
44	16	15	44	26	19
45	14	5	45	1	3
46	3	2	46	16	16
47	33	17	47	25	14

Table 24

RAW DATA ON GRADE TWELVE DIVIDED BY SEXES

GIRLS PUPIL #	PICTURES	WORD	BOYS PUPIL #	PICTURES	WORDS
1	21	16	1	29	26
2	33	29	2	28	22
3	28	30	3	18	19
4	16	12	4	33	30
5	13	15	5	23	19
6	14	11	6	27	16
7	12	8	7	21	19
8	28	24	8	20	20
9	25	25	9	20	23
10	34	25	10	19	17
11	17	11	11	22	12
12	15	13	12	26	30
13	22	22	13	11	4
14	32	25	14	23	20
15	18	13	15	28	30
16	11	8	16	21	20
17	27	21	17	32	28
18	7	6	18	15	18
19	26	30	19	25	18
20	21	22	20	22	20
21	25	2	21	18	15
22	23	19	22	32	27
23	33	33	23	26	24
24	30	28	24	22	23
25	32	29	25	13	12
26	29	24	26	14	9
27	23	23	27	20	23
28	5	2	28	30	28
29	35	34	29	22	11
30	14	15	30	11	9
31	35	37	31	15	8
32	27	30	32	18	16
33	14	3	33	12	10
34	12	14	34	10	10
35	19	21	35	27	23
36	34	29	36	30	25
37	3	0	37	29	26
38	14	13	38	30	15
39	23	22	39	18	11
40	22	18	40	7	0
41	15	14	41	13	6
42	17	20	42	25	5
43	21	11	43	14	10

Table 25

RAW DATA FOR GRADE THREE DIVIDED BY READING LEVEL

Low			High		
Pupil #	Pictures	Words	Pupil #	Pictures	Words
1	2	1	1	11	6
2	2	0	2	25	20
3	3	0	3	5	0
4	14	2	4	1	5
5	2	1	5	4	6
6	9	1	6	2	2
7	2	2	7	24	11
8	1	0	8	14	7
9	3	0	9	14	6
10	16	7	10	8	8
11	4	0	11	7	2
12	10	0	12	8	2
13	0	1	13	7	2
14	2	1	14	17	14
15	4	3	15	8	0
16	9	3	16	13	2
17	1	1	17	2	0
18	0	1	18	8	8
19	10	3	19	9	1
20	7	3	20	14	7
21	7	5	21	23	12
22	3	2	22	2	0
23	5	1	23	11	2
24	4	2	24	1	2
25	12	3	25	13	2
26	7	0	26	10	0
27	6	0	27	4	0
28	4	0	28	6	4
29	29	19	29	14	5
30	3	0	30	4	1
31	5	5	31	5	5
32	9	4	32	6	2
33	8	4	33	4	3
34	5	3	34	10	3
35	9	2	35	19	9
36	5	3	36	6	3
37	3	0	37	6	0
38	5	0	38	18	13
39	7	0	39	6	4
40	5	0	40	4	1
41	1	0	41	3	0

Table 26

RAW DATA FOR GRADE EIGHT DIVIDED BY READING LEVEL

Low			High		
Pupil #	Pictures	Words	Pupil #	Pictures	Words
1	11	1	1	18	22
2	2	0	2	26	16
3	15	13	3	37	29
4	19	11	4	23	14
5	8	8	5	32	28
6	19	11	6	20	12
7	11	9	7	33	28
8	17	5	8	22	24
9	14	5	9	20	28
10	6	6	10	32	28
11	14	5	11	29	29
12	23	14	12	1	3
13	9	5	13	7	8
14	1	0	14	35	25
15	2	3	15	13	6
16	29	26	16	16	19
17	11	7	17	4	7
18	3	3	18	25	17
19	9	1	19	16	18
20	4	8	20	26	16
21	5	1	21	17	15
22	5	1	22	25	23
23	14	15	23	11	10
24	6	6	24	22	14
25	21	18	25	27	19
26	28	20	26	21	5
27	25	14	27	12	12
28	16	4	28	11	9
29	10	7	29	11	5
30	6	4	30	14	10
31	16	15	31	24	9
32	24	10	32	24	28
33	0	1	33	23	15
34	21	7	34	16	16
35	11	5	35	21	25
36	22	18	36	28	16
37	25	17	37	26	19
38	3	1	38	16	10
39	15	9	39	17	10
40	11	6	40	11	6
41	3	1	41	13	13
42	6	2	42	15	12
43	3	2	43	9	14
44	8	5	44	1	3
45	33	17	45	20	23
46	13	4	46	10	18
47	15	12	47	25	17
48	5	2	48	25	26
49	10	12	49	25	24

Table 27

RAW DATA FOR GRADE TWELVE DIVIDED BY READING LEVEL

Low			High		
Pupil #	Pictures	Words	Pupil #	Pictures	Words
1	22	11	1	30	28
2	30	28	2	11	4
3	17	11	3	15	8
4	14	3	4	32	25
5	12	14	5	33	33
6	34	29	6	32	29
7	3	0	7	21	11
8	21	19	8	11	9
9	14	13	9	26	30
10	25	8	10	23	22
11	16	12	11	28	24
12	27	16	12	28	30
13	15	14	13	35	37
14	18	15	14	26	24
15	22	18	15	19	17
16	13	15	16	21	16
17	18	16	17	21	22
18	12	8	18	19	14
19	15	5	19	29	24
20	25	25	20	35	34
21	7	0	21	21	21
22	30	15	22	25	18
23	18	11	23	26	22
24	22	20	24	14	10
25	5	2	25	28	30
26	22	12	26	15	18
27	22	23	27	20	23
28	14	9	28	12	10
29	25	2	29	11	8
30	7	6	30	23	23
31	33	30	31	14	11
32	33	29	32	19	21
33	32	27	33	13	12
34	22	9	34	15	13
35	10	10	35	17	20
36	18	13	36	23	19
37	27	23	37	18	19
38	30	25	38	23	20

Table 28

RAW DATA FOR GRADE THREE DIVIDED BY ACHIEVEMENT LEVEL

110 or Below			Above 110		
Pupil #	Pictures	Words	Pupil #	Pictures	Words
1	5	0	1	3	0
2	11	6	2	2	2
3	2	1	3	2	1
4	4	6	4	22	8
5	3	0	5	14	7
6	14	2	6	14	6
7	9	1	7	7	2
8	1	0	8	8	2
9	8	0	9	2	2
10	0	1	10	17	14
11	1	1	11	13	2
12	0	1	12	9	1
13	10	3	13	5	7
14	23	12	14	9	3
15	7	5	15	14	7
16	3	2	16	11	2
17	7	0	17	13	2
18	4	0	18	1	0
19	6	2	19	4	0
20	3	0	20	6	4
21	9	4	21	14	5
22	8	4	22	5	5
23	5	0	23	4	3
24	5	0	24	19	9
25	5	3	25	5	3
26	18	13	26	3	0
27	2	0	27	6	4
28	10	0	28	7	0
29	5	1	29	9	2

Table 29

RAW DATA FOR GRADE EIGHT DIVIDED BY ACHIEVEMENT LEVEL

110 or Below			Above 110		
Pupil #	Pictures	Words	Pupil #	Pictures	Words
1	16	15	1	25	24
2	11	9	2	24	10
3	14	5	3	22	24
4	21	7	4	17	5
5	11	5	5	32	28
6	3	2	6	20	28
7	26	16	7	9	14
8	20	23	8	15	12
9	11	6	9	23	14
10	15	9	10	18	22
11	1	3	11	11	6
12	3	1	12	17	10
13	25	17	13	26	19
14	13	13	14	37	29
15	16	10	15	32	28
16	1	3	16	28	16
17	2	3	17	11	10
18	16	4	18	29	26
19	15	13	19	25	26
20	11	1	20	22	14
21	6	4	21	27	19
22	19	11	22	21	5
23	0	1	23	12	12
24	6	2	24	11	9
25	26	16	25	25	17
26	6	6	26	14	10
27	16	18	27	6	6
28	3	3	28	24	9
29	9	1	29	10	12
30	4	8	30	24	28
31	5	1	31	20	12
32	11	5	32	25	14
33	19	11	33	23	15
34	5	i	34	29	29
35	14	15	35	16	16
36	8	5	36	21	25
37	14	2	37	4	7
38	8	8	38	17	15
39	21	18	39	25	17
40	8	5	40	25	23
41	28	20	41	33	28
42	10	7	42	23	14
43	9	5	43	7	8
44	16	19	44	35	25
45	14	5	45	13	6

Table 30

RAW DATA FOR GRADE TWELVE DIVIDED BY ACHIEVEMENT LEVEL

110 or Below			Above 110		
Pupil #	Pictures	Words	Pupil #	Pictures	Words
1	22	9	1	26	30
2	27	23	2	35	37
3	26	22	3	21	19
4	18	19	4	18	15
5	21	16	5	13	12
6	30	25	6	16	12
7	17	11	7	14	10
8	30	15	8	20	20
9	7	0	9	22	22
10	25	25	10	23	22
11	25	5	11	11	4
12	12	8	12	27	21
13	25	8	13	26	24
14	15	14	14	23	23
15	14	9	15	15	18
16	22	11	16	32	27
17	22	20	17	13	6
18	5	2	18	21	21
19	12	14	19	21	11
20	34	29	20	29	26
21	14	13	21	18	11

APPENDIX B

PRESENTATION ORDER OF PAIRS

1.	EGG	LUF	picture
2.	BED	GUK	word
3.	POT	KYX	picture
4.	NUTS	ROH	word
5.	APPLE	WOH	picture
6.	DRUM	VID	word
7.	SPOON	JIS	picture
8.	CLOCK	QIN	word
9.	BABY	CYR	picture
10.	RING	FOW	word
11.	PIANO	FAH	picture
12.	CAR	LOH	word
13.	WATCH	VOD	picture
14.	TIE	BEM	word
15.	SHIRTS	HYL	picture
16.	CAKE	JYN	word

TESTING ORDER

1.	WATCH	picture
2.	RING	word
3.	BABY	picture
4.	CLOCK	word
5.	EGG	picture
6.	NUTS	word
7.	SPOON	picture
8.	TIE	word
9.	APPLE	picture
10.	BED	word
11.	POT	picture
12.	CAKE	word
13.	SHIRTS	picture
14.	CAR	word
15.	PIANO	picture
16.	DRUM	word

EXAMPLES:

1.	GLASS	BYC	picture
2.	BREAD	SUF	word

The order of the presentation of the pairs of paired-associates and also the order of the stimulus terms used for the testing were changed from showing to showing using the following order of presentation:

1-16	first showing
4-3	second showing
7-6	third showing
10-9	fourth showing
13-12	fifth showing

Name _____

Grade _____

Examples:

1._____

2._____

Teacher_____

First try.

1._____

2._____

3._____

4._____

5._____

6._____

7._____

8._____

9._____

10._____

11._____

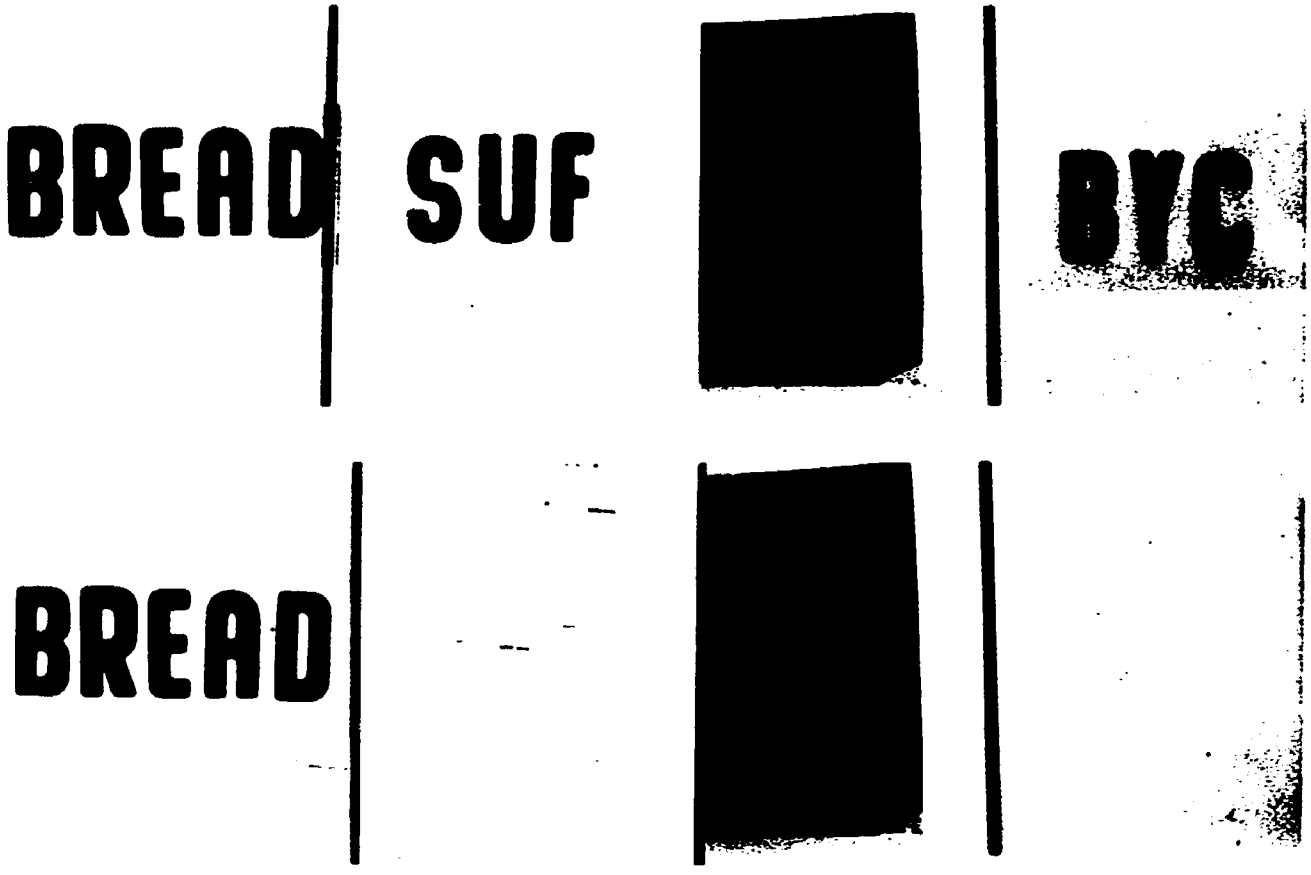
12._____

13._____

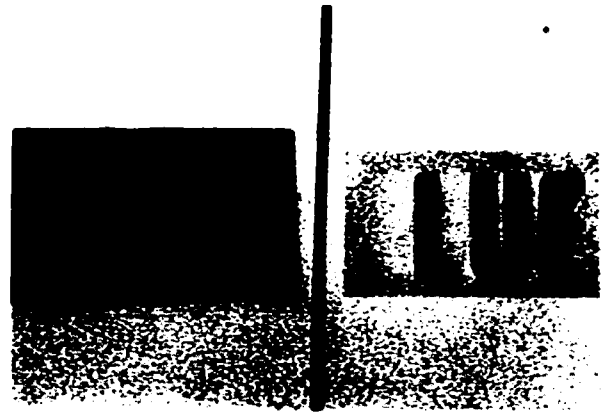
14._____

15._____

16._____


BREAD SUF
BYC
BREAD

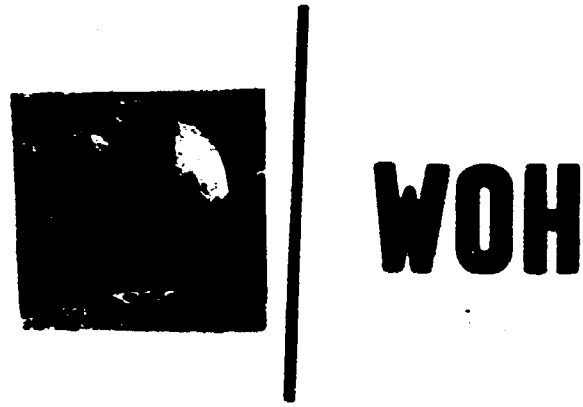
BED | GUK

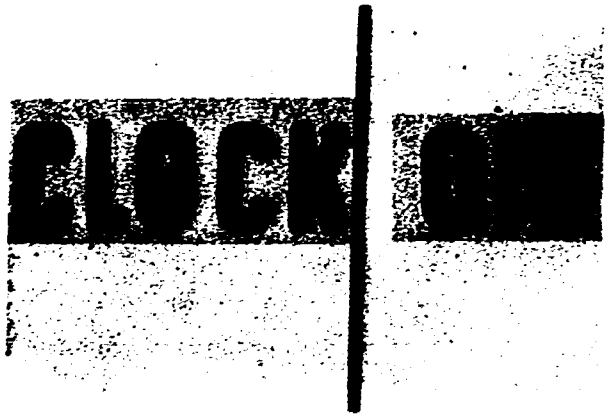




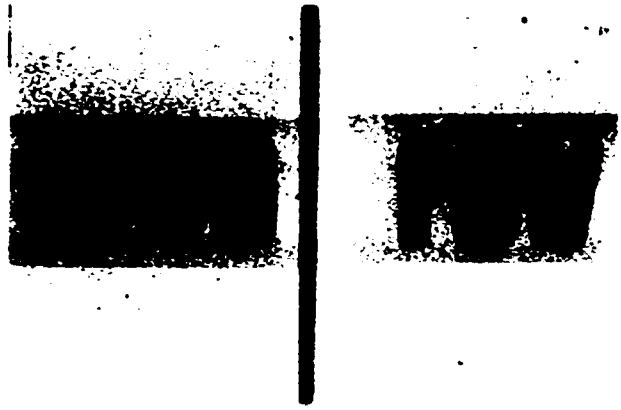






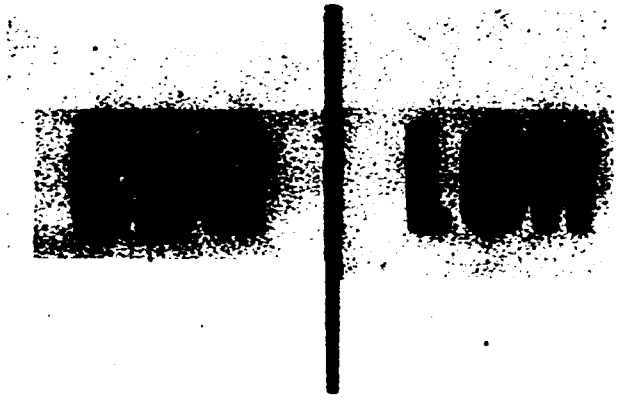




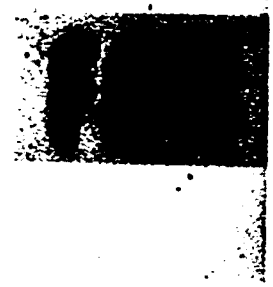




CYR







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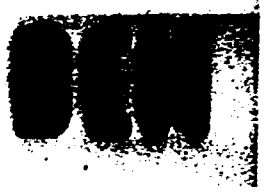
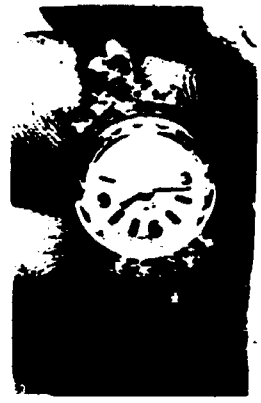
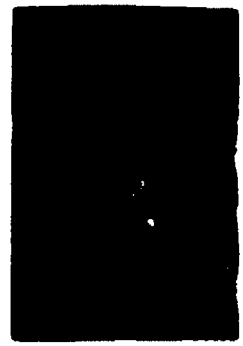




VOD

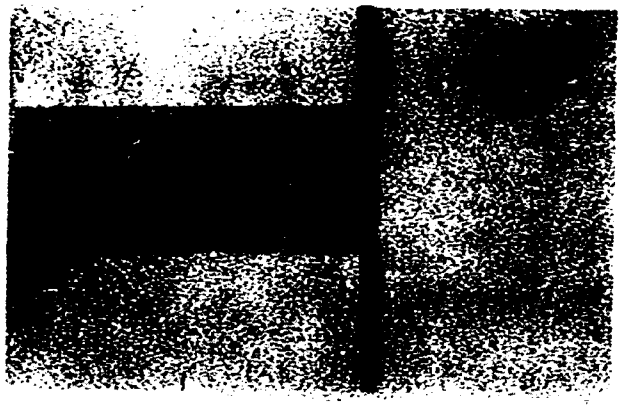




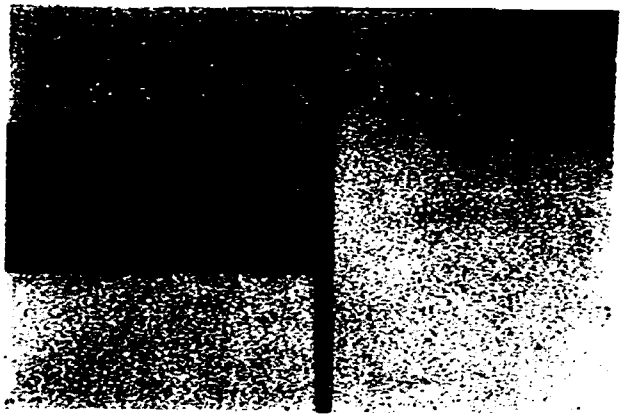
HYL

RING











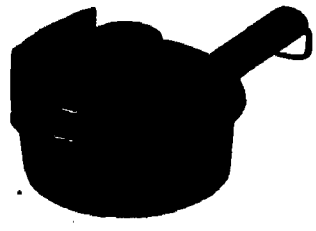




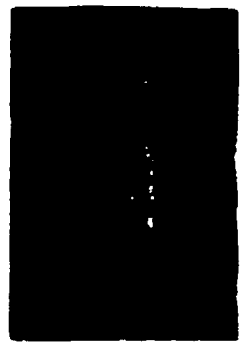
BED



CAKE



CAR



DRUM



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