INFORMATION TO USERS

This dissertation was produced from a microfilm copy of the original document. While the most advanced technological means to photograph and reproduce this document have been used, the quality is heavily dependent upon the quality of the original submitted.

The following explanation of techniques is provided to help you understand markings or patterns which may appear on this reproduction.

1. The sign or “target” for pages apparently lacking from the document photographed is “Missing Page(s)”. If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting thru an image and duplicating adjacent pages to insure you complete continuity.

2. When an image on the film is obliterated with a large round black mark, it is an indication that the photographer suspected that the copy may have moved during exposure and thus cause a blurred image. You will find a good image of the page in the adjacent frame.

3. When a map, drawing or chart, etc., was part of the material being photographed the photographer followed a definite method in “sectioning” the material. It is customary to begin photoing at the upper left hand corner of a large sheet and to continue photoing from left to right in equal sections with a small overlap. If necessary, sectioning is continued again – beginning below the first row and continuing on until complete.

4. The majority of users indicate that the textual content is of greatest value, however, a somewhat higher quality reproduction could be made from “photographs” if essential to the understanding of the dissertation. Silver prints of “photographs” may be ordered at additional charge by writing the Order Department, giving the catalog number, title, author and specific pages you wish reproduced.

University Microfilms
300 North Zeab Road
Ann Arbor, Michigan 48106
A Xerox Education Company
DiOBILDA, Nicholas Anthony, 1943-
EFFECTS OF WORD LIST TYPES ON ACQUISITION,
RETENTION, AND TRANSFER IN CHILDREN'S
PAIRED-ASSOCIATE LEARNING.

The Ohio State University, Ph.D., 1972
Education, psychology

University Microfilms, A XEROX Company, Ann Arbor, Michigan
PLEASE NOTE:

Some pages may have
indistinct print.
Filmed as received.

University Microfilms, A Xerox Education Company
VITA

December 2, 1943 ........
1965 ....................
1965-66 .................
1966-70 ............... 
1970 ...................
1970-72 ............... 

Born - Utica, New York
B.S., West Chester State College,
West Chester, Pennsylvania
High School English Teacher,
Syracuse, New York
High School English Teacher,
Wilmington, Delaware
M. Ed., University of Delaware,
Newark, Delaware
N.D.E.A. Fellow, The Ohio State
University, Columbus, Ohio

FIELDS OF STUDY

English Education
Reading
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Background to the Problem</td>
<td>1</td>
</tr>
<tr>
<td>The Problem</td>
<td>5</td>
</tr>
<tr>
<td>Paired Associate Learning</td>
<td>7</td>
</tr>
<tr>
<td>Transfer and Retention</td>
<td>9</td>
</tr>
<tr>
<td>Conditions of Presentation and Psychological Processes</td>
<td>11</td>
</tr>
<tr>
<td>Design of the Study</td>
<td>18</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>19</td>
</tr>
<tr>
<td>Significance of the Study</td>
<td>20</td>
</tr>
<tr>
<td>Limitations</td>
<td>23</td>
</tr>
<tr>
<td>Summary</td>
<td>25</td>
</tr>
<tr>
<td>II. REVIEW OF LITERATURE</td>
<td>29</td>
</tr>
<tr>
<td>Learning and Similarity Relationships</td>
<td>30</td>
</tr>
<tr>
<td>Summary of Review of Similarity Relationships</td>
<td>44</td>
</tr>
<tr>
<td>Cue Selection</td>
<td>46</td>
</tr>
<tr>
<td>Summary of Cue Selection</td>
<td>55</td>
</tr>
<tr>
<td>Review of Transfer Literature</td>
<td>57</td>
</tr>
<tr>
<td>Summary of Transfer Literature</td>
<td>65</td>
</tr>
<tr>
<td>Review of Retention Literature</td>
<td>66</td>
</tr>
<tr>
<td>Summary of Retention Literature</td>
<td>71</td>
</tr>
<tr>
<td>III. EXPERIMENTAL DESIGN</td>
<td>73</td>
</tr>
<tr>
<td>Subjects</td>
<td>73</td>
</tr>
<tr>
<td>Definitions</td>
<td>74</td>
</tr>
<tr>
<td>Procedures</td>
<td>75</td>
</tr>
<tr>
<td>Stimulus Materials</td>
<td>80</td>
</tr>
<tr>
<td>Collection of Data</td>
<td>82</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>82</td>
</tr>
<tr>
<td>Methods of Analysis</td>
<td>84</td>
</tr>
<tr>
<td>IV. RESULTS</td>
<td>Page</td>
</tr>
<tr>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td>91</td>
</tr>
<tr>
<td>Cue Selection</td>
<td>91</td>
</tr>
<tr>
<td>Acquisition</td>
<td>96</td>
</tr>
<tr>
<td>Retention</td>
<td>100</td>
</tr>
<tr>
<td>V. DISCUSSION OF RESULTS</td>
<td>105</td>
</tr>
<tr>
<td>Introduction</td>
<td>105</td>
</tr>
<tr>
<td>Cue Selection</td>
<td>108</td>
</tr>
<tr>
<td>Similarity</td>
<td>111</td>
</tr>
<tr>
<td>Transfer</td>
<td>113</td>
</tr>
<tr>
<td>Retention</td>
<td>116</td>
</tr>
</tbody>
</table>

APPENDIX ................................. 120

BIBLIOGRAPHY .............................. 124
# LIST OF TABLES AND FIGURES

<table>
<thead>
<tr>
<th>Tables</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>77</td>
</tr>
<tr>
<td>2</td>
<td>83</td>
</tr>
<tr>
<td>3</td>
<td>86</td>
</tr>
<tr>
<td>4</td>
<td>89</td>
</tr>
<tr>
<td>5</td>
<td>92</td>
</tr>
<tr>
<td>6</td>
<td>92</td>
</tr>
<tr>
<td>7</td>
<td>93</td>
</tr>
<tr>
<td>8</td>
<td>93</td>
</tr>
<tr>
<td>9</td>
<td>95</td>
</tr>
<tr>
<td>10</td>
<td>95</td>
</tr>
<tr>
<td>11</td>
<td>97</td>
</tr>
<tr>
<td>12</td>
<td>98</td>
</tr>
<tr>
<td>13</td>
<td>101</td>
</tr>
<tr>
<td>14</td>
<td>103</td>
</tr>
</tbody>
</table>

1. Order and Sequence of Events
2. Word Lists
3. Data Matrix for Acquisition (or Retention)
4. Data Matrix for Stimulus Selection Measures
5. Analysis of Variance on List 4--List 1 Testing vs. No List 1 Testing
6. Means and Standard Deviations of Contrast Group by Testing on List 1 vs. No Testing on List 1
7. Analysis of Variance for List 4 Cue Selection Scores
8. Means and Standard Deviations of List 4 Cue Selection Scores
9. Analysis of Variance for Cue Selection on Lists 1 and 4
10. Means and Standard Deviations of List 1 and List 4--Cue Selection Measures
11. Analysis of Variance for Acquisition Data
12. Group Means and Standard Deviations for Acquisition Data
13. Analysis of Variance for Retention Data
14. Group Means and Standard Deviations for Retention Data
<table>
<thead>
<tr>
<th>Figures</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acquisition Means for Successive Lists</td>
<td>99</td>
</tr>
<tr>
<td>2</td>
<td>Group Means for Retention</td>
<td>102</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

Background to the Problem

Nearly all methods of reading instruction seek to control the presentation of new words during the initial stages of learning to read. Linguistic and phonic methods seek to promote transfer of skills to facilitate identification of new words by controlling the number of new orthographic patterns introduced in a lesson (Bloomfield and Barnhart, 1961; Fries, 1962; Sofietti, 1955). In basal oriented methods control is exercised by selecting for initial learning either a limited number of words having a high frequency of occurrence in common usage or words that have been identified as known by children (Anderson and Dearborn, 1952; Betts, 1957; Dolch, 1928; Gates, 1926; Harris, 1956; Hildreth, 1949; Horn, 1928; Thorndike, 1932). Retention is fostered by repetition of words (Harris, 1970). The language experience method utilizes a child's speaking vocabulary as a source of words for reading materials (Spache and Spache, 1969; Stauffer, 1969). The language experience approach attempts to promote retention by development of the student's own clues to memory (Stauffer, 1969).
The basal reader oriented method and language experience approach emphasize acquisition and retention, while the phonics and linguistic methods emphasize acquisition and transfer. Each method seeks to control the presentation of words. The basal reader method uses semantic controls over words. The language experience approach emphasizes student controls. Linguistic and phonic approaches use graphemic and phonemic controls. An examination of some linguistic and basal beginning reading texts reveals how orthographic characteristics of words are treated in methodology.

The method of presenting words advocated by Bloomfield, Fries, and Sofietti represents a condition of grouping the similar items together to be learned at the same time. The items are orthographically and phonemically similar. For example, Bloomfield (1961) stated that in initial reading instruction, words with regular spellings be presented first. The task of the child is to distinguish between words when they are presented together. Bloomfield's examples include "bat," "cat," "fat," or "bad," "bag," "bat," each group varying in only one graphemic and phonemic position. The first books in the linguistic series Let's Read by Leonard Bloomfield and Clarence Barnhart (1961) put words together which have only a minimal contrast of graphemic and phonemic features between words. The Merrill Linguistic Readers by Charles
Fries, Agnes Fries, Rosemary Wilson, and Mildred Rudolph (1966) and the *Miami Linguistic Readers* (1966), a Ford Foundation project for disadvantaged students, also include minimal contrast words in the introductory readers. Examples from *Book A* of the *Merrill Linguistic Readers* include "cat," "fat," "pat," and "mat." Examples from *Level B-1* of the *Miami Linguistic Readers* include "kid," "kit" and "fish," "wish."

In contrast, a second condition, the traditional method of presenting words as exemplified in basal reader preprimers and primers does not group words by orthographic or phonemic similarity. There are many guidelines used to include words in basal materials. Examples are high interest, high meaning, frequency in oral and written language, or utility in furthering word attack skills. For example, *The Bank Street Readers* (Bank Street School of Education, 1965) represent a basal series which uses high interest and high meaning as the criteria for inclusion of words in the preprimers and primers. Some of the first words that a child learns are: "boys," "girls," "house," "street," "people," "stores," "school," "city," "night," "light" (Bank Street School of Education, 1965, p. 122). In the teacher's guide, a special caution is given to teachers about the word pairs "street," "school," and "night," "light." The authors of the teacher's guide state that each word may serve as a source of confusion with "street" and "school."
procedures are outlined for helping the student discriminate between words which are orthographically similar (Bank Street School of Education, 1965, p. 222). The inclusion of similar words is regarded as a special problem to be handled by special instruction. Similar words were taught because of the content of the story, not because of orthographic or phonemic considerations.

Another example offers further illustration. In Opening Books, the first preprimer of The Macmillan Reading Program (Harris and Clark, 1965) presentation of similar words is also regarded as a special problem. For example, "Mike" is the first word learned. Twenty-two words later the word "bike" appears. In the third preprimer Things You See, the word "like" appears. The teacher's guide to the lesson in which "bike" appears cautions the teacher about the possibility of confusion with "Mike" and offers special directions for helping the student discriminate between the two (Harris and Clark, 1965, p. 166).

Thus, in linguistic oriented materials, similar words are presented together by design, whereas in traditional materials the cooccurrence is by chance. Linguistic methods hold the presentation of similar items as a guiding principle of instruction, whereas traditional methods regard similarities among words as special problems requiring special instruction apart from the usual procedures of helping students learn to read words. Linguistic methods seek
to promote generalization of graphemic-phonemic relationships which will facilitate identification of new words. Traditional methodology regards the presence of similar items as sources of confusion for word recognition (Bank Street School of Education, 1965; Harris and Clark, 1965). In either case the beginning reader may or may not extract similarity relationships and use them to identify new words. The extent to which similarity relationships affect identification and recognition of words may depend upon the degree of learning, the content of learning, retention of items learned, and specific and general transfer.

Another factor which may influence learning is the manner in which similar words are presented. Linguistic materials present similar words in mass. Traditional materials present orthographically similar words in a non-systematic fashion. A third condition of presentation is possible. Words which are orthographically similar could be presented in the following planned sequence. After original learning of a group of dissimilar words, other words bearing similarities with the original words could be presented. The effects on learning by this method of presentation would also be dependent upon retention and transfer.

The Problem

Acquisition, retention, and transfer are important to building word identification skills and to promoting
subsequent word recognition. One factor which influences acquisition, retention, and transfer is method of presenting stimuli. Traditionally, however, the semantic aspect of words has been considered important (Anderson and Dearborn, 1952; Betts, 1957; Gates, Hemke, and Van Alstyne, 1926). Also considered an important influence on learning to read words is the orthographic character of the words.

The purpose of this study was to examine how method of presentation affected acquisition, retention and transfer, while controlling orthographic characteristics. Furthermore, subsequent learning and retention of word lists as influenced by prior learning was investigated.

Three types of word lists were constructed. They were:

1. Minimal Contrast Lists
2. Systematic Contrast Lists
3. Random Contrast Lists

Each type contained four separate word lists. Minimal contrast lists had intra-list similarity, but no planned inter-list similarity. Systematic contrast lists had inter-list, but no planned intra-list similarity. Random contrast lists had no planned intra-list or inter-list similarity. The three conditions of presentation were defined by the type of word lists the subjects learned.

The following sections of Chapter I give background information on paired-associate learning, transfer, and retention. Another section describes the conditions of
presentation of word lists and the psychological processes which may affect learning and retention. Other sections discuss hypotheses, the design of the study, its significance, and its limitations. Finally, there is a summary of Chapter I.

**Paired-Associate Learning**

The type of learning this study investigated was paired-associate learning. The paired-associate task consists of a series of pairs of items in which one item of the pair serves as a stimulus and the second item as the response. The learner is required to associate the stimulus with the response (Hall, 1971, p. 313).

The procedure used in this experiment was a variation of the study-test method of paired-associate learning. Subjects were presented a graphic and oral stimulus for each item in the list. The subject's task was to associate the oral stimulus with the graphic stimulus; thus the oral stimulus also served as the response. In practice, after one study trial the subject had to provide the correct oral response to each graphic stimulus. Errors or non-responses to the graphic stimulus were prompted with the correct oral response. For acquisition trials, the number of correct responses for fifteen study-test trials constituted the dependent variable.

A number of processes have been proposed to account for the learning that takes place in the paired-associate
task. Underwood and Schulz (1960) proposed a two-stage model. The two stages are a response availability stage and an associative or hook-up stage. In the first, the subject acquires the necessary responses. In the second stage, the subject learns to associate the available responses to the stimuli.

Building upon the Underwood and Schulz model, a number of investigators have supplemented the model with mediational constructs which may also be involved in paired-associate learning. McGuire (1961) felt that subjects associated a mediating stimulus-producing response with each stimulus. Hall (1971, p. 318) explained the mediated stimulus-producing response. He said, "This is an encoding process by which the subject discriminates that stimulus from other stimuli in the list and at the same time identifies it, frequently in an idiosyncratic way." In short, McGuire added a stage in which the subject learns to discriminate stimuli from other stimuli in the list.

Newman (Hall, 1971, p. 320) added a response discrimination stage to the model. Response term discrimination was similar to McGuire's stimulus discrimination stage, the only difference being the part of the pair in which discrimination occurs.

Hall (1971, p. 322) summarized a listing of processes involved in paired-associate learning. The following list, adapted from Hall's list, includes those processes which
are important to this study:

1. Discrimination of stimulus and response terms—the subject learns to discriminate from each other individual items in the stimulus or response terms.

2. Response learning—the subject learns the response sufficiently well to produce it in the presence of the appropriate stimulus.

3. Stimulus selection and coding—the subject transforms a nominal stimulus into a functional one.

4. Stimulus-response association—the subject learns to associate a specific response with a specific stimulus.

5. Mediated association—the subject uses extra-list associations to facilitate the stimulus-response association.

The section of the chapter entitled Conditions of Presentation and Psychological Processes discusses the relationship of these processes to the variables under investigation in this study.

Transfer and Retention

Transfer is concerned with the influence of prior practice upon performance in a new learning task. Prior practice may be a source of facilitation or interference in the acquisition of new materials. Transfer is not a gross phenomenon. Postman and Keppel (1969, p. 263) describe two kinds of transfer. They are: 1) general transfer and 2) specific transfer.

General transfer consists of generalizable habits and skills, the effects of which are independent of specific
similarity relations among tasks. Its effects are generally positive. "Learning to learn" is a kind of general transfer. "Learning to learn" may involve a change in the subject's mode of attack on a problem or may be just the habits and skills which are carried over from one task to another (Postman and Keppel, 1969, p. 264).

Specific transfer depends on knowledge of similarity relations between the components of successive learning tasks. For example, specific transfer can be considered a factor when a second group of words is learned after a first group has been acquired. Specific transfer will be either a cause of interference or facilitation in learning the second group of words. The similarity relations between the two groups of words will determine the nature of transfer. General and specific transfer operate together so that it is often difficult to determine how each component contributes to successive learning tasks. The net transfer effect may be viewed as the algebraic summation of the effects of the separate mechanisms (Kausler, 1966, p. 367).

Retention of words is influenced by a variety of factors. Underwood (1957) has hypothesized that forgetting is chiefly determined by proactive interference, that is, interference caused by prior learning. Postman and Keppel (1969, p. 400) state that interference in recall is closely tied to negative transfer in acquisition of a
response, and that the effects of similarity relations in transfer hold for interference as well. Postman and Keppel (1969, p. 404) further state that the recovery of prior habits and loss of differentiation are assumed to influence response competition at the time of recall. Thus, words learned at Time 1 can have their retention affected by their learning mates, or can be a source of interference for retention of subsequent items. Thus, similarity relationships within or between word groups should affect retention of the words.

Condition of Presentation and Psychological Processes

The ability of children to learn to read and remember words is a product of many factors. This study attempted to determine how similarity relationships between words and the manner of presentation of similar words affected learning and retention of word lists. Learning and retention of words varying in similarity and method of presentation were compared. Three conditions of presentation were compared.

Minimal contrast condition. The first method may be considered representative of the linguistic method as advocated by Bloomfield, Fries, and Sofietti. Similar items were presented together in the same list. Stimulus words varied in only a single position. In this study the variable position was the first only. Within lists, stimulus
words were orthographically similar while their oral pronunciations were phonemically similar. Hereafter, this condition will be called "minimal contrast."

The distinction between orthographic similarity of the written word (stimulus) and phonemic similarity of the oral response may be an important one. Verbal learning theory predicts that high stimulus similarity leads to more errors in learning (Hall, 1971, p. 171; Kausler, 1966, p. 224). However, similarity on the response side has been suggested as a source of facilitation for learning the responses (Levitt and Goss, 1961; Newman and Buckhout, 1962). Other processes known to operate in verbal learning may affect the acquisition and retention of word lists.

In this study, items within each minimal contrast list had to be discriminated on the basis of a single letter. In such a condition, stimulus or cue selection may become a factor in learning. Stimulus selection reduces the complexity of the learning task and aids the learner in differentiating among the other stimuli that make up the material to be learned (Hall, 1971, p. 233). A type of general transfer may result from a method of presentation which emphasizes words orthographically similar in every respect except a single invariant position.

A general transfer effect or a set for learning the words on the basis of a single discriminating cue may be established. Subsequent contact with similar learning
situations might strengthen this particular strategy of learning to read words (Richardson and Chisholm, 1969).

Degree of learning has also been demonstrated to be an important variable in cue selection (Hall, 1971, p. 235). When faced with compound stimuli, the learner may require frequent contact before he realizes he need not attend to all the parts. Selection may be minimal at first. As contact continues, the learner finds he can discriminate between stimuli on the basis of a single element. As stimuli continue to be presented, the learner may turn his attention to the remaining components of the stimulus and establish associations between those components and the responses (Davis, Brown, and Ritchie, 1968; James and Greeno, 1967; Lovelace and Blass, 1968).

Retention of minimal contrast lists is affected by many factors. Stimulus similarity may hinder retention (Melton and VonLackum, 1941). Response similarity may facilitate retention (Morgan and Underwood, 1950) or may have no effect (Young, 1955). Retention of subsequent lists is affected by proactive interference (Underwood, 1957). In addition, the specific effects of loss of differentiation and response competition may lead to a greater decrement in retention for items which are minimally contrasted.

In summary, learning groups of similar words should be a difficult task. The difficulty may be somewhat abated by
the fact that oral responses are similar. However, if the learner can detect a strategy for reducing the complexity of the task, learning should be greatly facilitated. In the case of word lists in which words have a minimal contrast of a single letter in a single invariant position, the discriminating letter should be the cue selected for learning words (Hall, 1971, p. 235; Postman and Keppel, 1969, p. 18). Furthermore, such a strategy of learning may be strengthened by subsequent contact with the same kind of learning situation. Degree of learning may affect the kind of transfer which occurs. While learning may be facilitated, no such benefit may be realized for retention. Stimulus similarity may decrease retention while the effects of response similarity may or may not aid retention. In addition, retention of minimal contrast items may be retarded because of general proactive interference and loss of discrimination among items.

Systematic contrast condition. A second condition of presentation is one in which a group of dissimilar words is learned first, then words similar to the original words are presented in subsequent lists. In reading materials, this condition may occur by chance (Bank Street School of Education, 1965, p. 122) or by design (Richardson, Smith, and Weiss, 1965, p. 143). Hereafter, this condition will be called "systematic contrast."
This study sought to determine the effect of a systematic presentation of words on acquisition and retention of word lists. This study also sought to determine the effects of systematic presentation when direct instruction about similarity relations or grapheme-phoneme correspondences was not given. As with the minimal contrast condition, learning under the systematic contrast condition involves psychological processes.

In the first systematic contrast group, orthographic stimuli and phonemic responses were dissimilar. Then words learned subsequently bore orthographic and phonemic similarities to the original words. It was hypothesized that learning the first list should be rapid because the words were dissimilar (Gibson, 1942; Underwood, 1953). Subsequent learning should be facilitated through the process of mediated transfer (Kausler, 1966, p. 370). In mediated transfer, items serve as links to elicit similar items rather than as sources of interference. As subsequent similar items continue to be learned, experience with the transfer situation should enhance the learner's ability to recognize similarity relations and to develop strategies of responding which maximize subsequent learning and minimize interference (Keppel and Postman, 1966). Furthermore, it is possible for mediation to occur without a conscious awareness of similarity relations (Bugelski and Scharlock, 1952; Norcross and Spiker, 1958).
Stimulus selection should not become a generalized method of learning words in a condition in which items differ within the list. Postman and Keppel (1969, p. 17) state, "If contextual features are variable, the nominal elements will be preponderant since they provide the only basis for the establishment of stable response contingencies."

Retention of systematic contrast items should be greater for original and subsequent items than items learned in the minimal contrast condition. In the original list, stimulus items are discriminable on the basis of more features and are less subject to response competition and loss of differentiation. In retaining subsequent items, Postman and Keppel (1969, p. 404) state "... the similarity relations effective in transfer hold for interference as well." If mediation serves as a source of factilitation in transfer, it should serve as a source of proactive facilitation in retention. Postman (1961, p. 159) states, "The assumption of direct mediation may help account for the failure to find rises in proactive interference with increasing response similarity as would be expected on the basis of the response generalization hypothesis." Further, "When response similarity is high, direct mediation not only provides practice on the first list during interpolated learning, but also maintains the second list responses at high strength."
Random contrast condition. A third condition of presentation of words is most common in basal reading materials. Words are selected for reasons other than graphemic or phonemic similarity. Any similarities which occur are due to the story and the natural limitations of our orthographic and phonemic systems. In other words, similarities are not planned. Thus, learning each word constitutes a separate task. Hereafter this condition will be called "random similarity."

Measures on learning, cue selection, and retention of the random similarity lists provide a baseline to assess the similarity effects of the minimal and systematic contrast conditions. Discriminable features of words in the random similarity condition are spread across many letter positions. Thus, cue selection should not become a generalized method of learning words. Original learning should be rapid (Gibson, 1942; Underwood, 1953). Subsequent learning should be more rapid than original learning. This increase is attributable to "learning to learn," a kind of general transfer. Increases in the speed of acquisition would be expected for learning successive unrelated words due to general transfer (Postman, 1964). In retention, a general decrement, independent of similarity relations, is expected on the basis of interference theory alone (Underwood, 1957; Slamecka and Ceraso, 1960). Thus, changes in learning and retention of unrelated word groups provide a baseline for
assessing the effect of similarity relations among the minimal and systematic contrast conditions of presentation.

Design of the Study

Acquisition, retention, cue selection, and transfer of learning were assessed under three conditions of presentation. The three conditions were minimal contrast, systematic contrast, and random contrast. The experiment can be envisioned as three separate repeated measures experiments. However, data can be analyzed in the same analysis of variance. The method of analysis for this mixed design is described by Lindquist (1953, p. 273). A separate analysis was used for each class of dependent variable. Tukey's procedure (Kirk, 1968, p. 88) was used to determine if differences between means were significant. A level of $p < .05$ was chosen as the level of significance.

Sixteen words for each contrast group were selected from the Dale-Schuh List of 1400 Words Known by 75% or More of First Grade Children in the Enrichment Program of the Columbus (Ohio) Public Schools (Dale and Schuh, 1971). The sixteen words for each group were divided into four lists of four words each. A random sample of twelve kindergarten children per contrast group learned one list of words per day for four days. A twenty-four hour retention test was given for each list of words. A cue selection test was given on the first and last day of the experiment. A modified paired-associate technique was used to teach the
words to the children.

**Hypotheses**

The following hypotheses were tested:

**H₁:** In the acquisition trials, the number of correct responses for each minimal contrast list should be greater than the number of correct responses for systematic or random contrast lists.

**H₂:** On the retention tests, fewer minimal contrast items should be recognized than random or systematic contrast items.

**H₃:** On both cue selection tests more minimal contrast items should be correctly identified than systematic or random contrast items.

**H₄:** More minimal contrast items should be correctly identified on the last cue selection test than on the first test.

**H₅:** In acquiring the first list of words, the number of correct responses for the systematic contrast group should equal the number of correct responses for the random contrast group.

**H₆:** In acquiring subsequent lists, the number of correct responses for the systematic contrast group should be greater than the number of correct responses for the random contrast group.

**H₇:** On the first retention test, the number of correct responses should be equal for the systematic and random contrast groups.

**H₈:** On subsequent retention tests, the number of correct responses should be greater for the systematic contrast group than for the random contrast group.
H₀: On both cue selection tests, the number of correct responses should be equal for the systematic and random contrast groups.

H₁₀: For the random and systematic contrast groups, the number of correct responses on the first cue selection test should equal the number of correct responses on the last cue selection test.

Significance of the Study

This research may contribute to knowledge about factors which influence children's ability to acquire and retain a limited reading vocabulary. The factors consist of two types:

1. The variables under investigation in this study
   a. Orthographic and phonemic similarity
   b. Context of presentation of similarity relationships

2. The psychological processes involved in learning and retaining a group of words for a limited reading vocabulary.

Conditions of similarity and their presentation have been related to various types of reading methodology and materials. The minimal contrast part of the experiment will test in part the validity of claims made by certain linguists about the type of words which should be learned first. The systematic contrast part of the experiment will determine if there is any reason to believe that, without instruction in phoneme-grapheme relationships, contact with words similar to those learned previously will lead to more rapid learning of subsequent words, or will lead to interference. The random contrast group provides a baseline
for comparing acquisition and retention of the words in the other contrast groups.

In this experiment, no special instruction is given regarding any of the similarity relationships. The effects of similarity relationships without instruction is of prime interest to the experimenter. Type of instruction itself may be an important variable which affects learning word lists. Also, of interest are the effects of repeated exposure to each of the conditions of presentation.

Traditional criteria for inclusion of words in basic reading materials have been semantically based. Orthographic similarity has been regarded as an unavoidable problem. This experiment offered more evidence to show the specific effects of similarity relationships when semantic difficulty remains constant. For those who are interested in the orthographic characteristics of words, information from this experiment may contribute to knowledge about how the variables under investigation affect learning and retention.

This experiment also provided information about the psychological processes involved in learning and remembering word lists. Again, the major area of interest is how children handle similarity relationships in materials with which they are relatively unfamiliar. Other studies have explored how adult subjects handle semantically similar materials. This experiment used naive kindergarten subjects
to investigate how they handled orthographically similar stimuli and phonemically similar responses in different conditions of presentation.

This experiment also yielded information about learning by cue selection. The relationship of cue selection to the materials being learned was investigated. If cue selection does occur, is it with maximally or minimally discriminable words? In addition, this experiment sought to determine if subjects adopted a strategy of learning by cue selection after repeated exposure to the same kind of materials.

The systematic contrast part of the experiment was an adaptation of a transfer paradigm. Mediated transfer facilitates learning of subsequent similar materials. However, most experiments have used adult subjects with materials which have associative similarity. This experiment used kindergarten subjects to determine if mediated transfer occurred with orthographically similar stimuli and phonemically similar responses in the systematic contrast condition.

Finally, this experiment examined the relationship of retention to the types of similar materials in the study. Underwood (1957) has stated that forgetting is caused by proactive interference. This experiment examined proactive interference in naive subjects who could read no words other than their own names prior to the experiment.
Limitations

This experiment had certain limitations. First, the nature of the learning task permitted only a limited generalization to reading methodology. Words were learned in a paired-associate task with only the written word as a stimulus, the oral pronunciation as the response, and an oral prompting for errors or non-responses after the first trial. Words were presented in isolation so the effects of the contrast conditions would not be confounded by the effects of other cues. Other cues normally used in reading instruction were not included, so no assessment of their effects in combination with similarity relationships can be made. Since each list provided only a limited sample of words that could be selected for an initial reading vocabulary, generalization was restricted to the sample of word types investigated. Another limitation of the study was that it did not provide information about how subjects may have acquired and used knowledge of phoneme-grapheme relationships to facilitate learning new words. Reading methodologists consider such knowledge important in transfer of ability to attacking new words (Chall, 1967). This study does not investigate that type of transfer.

Another major limitation concerns the similarity relationships. In the minimal contrast group, all letters and phonemes for each word list were identical except for the first. The systematic presentation of similar words also had
only one variable orthographic and phonemic position, although the similarity was between lists rather than within lists. Other degrees of similarity were not investigated, so generalization is limited to the type of materials used in this study. In addition, orthographic and phonemic similarity covaried. It is possible to have words with phonemic similarity but orthographic dissimilarity, or vice versa. The homonyms "brake," "break" illustrate the former case. "Through" and "thought" illustrate the latter case. In this experiment, the differential effects of each type of similarity could not be determined.

Degree of learning is another variable which may influence results but was not investigated. The degree of learning was set at the number of correct responses per fifteen trials. Within this criterion, any number of degrees of learning is possible. Since degree of learning has been demonstrated to be a variable in retention, transfer, and cue selection, the lack of control in this experiment may be a confounding factor. Degree of learning could not be controlled because of the nature of the subjects and the conditions in which the experiment was run. Subjects were unfamiliar with strategies to learn to read words, and the time necessary for working with individual subjects was limited.

Finally, the subjects in this experiment were students who could read no words other than their own names. They
had received discrimination training, and many could identify individual letters. The subjects were kindergarten pupils who were a few months younger than the age at which reading instruction usually begins. However, the experiment was conducted at the end of the kindergarten year so that the age limitation would be minimized. Thus, the results of this experiment are only generalizable to students who are at the initial stage of reading instruction. The effects of similarity relations on acquisition, retention, transfer, and cue selection cannot be generalized to students who have already attained the ability to read words. Postman (1961) has indicated that already established letter sequence habits may exert a different kind of influence on learning and retention.

Summary

Scholarly debate has always accompanied reading methodology. One aspect of reading methodology, initial acquisition of a limited reading vocabulary, has been selected as the topic of this study. Debate has also surrounded this particular aspect.

Various authorities recognize the need for the rapid acquisition of an initial reading vocabulary. Relevant to the question of how to foster rapid acquisition are the topics of vocabulary control and method of instruction. Traditional controls as exemplified in
basal readers use semantic controls. In contrast, linguists have called for controls which enable the learner to acquire phoneme-grapheme correspondences and which promote transfer to attacking new words. Appropriate materials have been written and used in classrooms.

This study attempted to examine acquisition, retention, and transfer in paired-associate learning by comparing three methods of presentation of word lists.

Each method used repeated measures of a similar type word list. Three groups of kindergarten children learned four word lists on four successive days and were given a twenty-four hour retention test for each list. Cue selection measures were taken on the first and last days.

In the minimal contrast group, children learned words which had intra-list similarity, but no systematic inter-list similarity. In the systematic group, children learned words which had inter-list similarity, but no systematic intra-list similarity. In the random group, children learned words which had no systematic intra-list or inter-list similarity. Hypotheses were predicted about learning and retention of each type of word list.

Three conditions of presentation of words were examined to assess the effects of similarity relationships on acquisition, retention, and transfer of word lists. In the minimal contrast condition, rapid acquisition, but poor retention were hypothesized. The effects should have
become more pronounced under repeated presentations of minimal contrast lists. A by-product of the minimal contrast condition was a general set to learn words on the basis of a single discriminating feature. A stimulus selection effect was hypothesized for learning minimal contrast lists.

In the systematic contrast condition, original learning and retention should have equaled the randomized group. Subsequent learning and retention of lists which are similar to the original list should have been facilitated through mediation processes. An increment in learning and retention was hypothesized for subsequent lists. No stimulus selection set was expected to develop.

The randomized similarity list represented a condition in which orthographic and phonemic similarity occurred on a random basis. This condition provided a baseline to assess the similarity effects of the other conditions.

This research served to examine the effects of method of presentation of orthographically and phonemically controlled lists on the acquisition, and retention of words by beginning readers. If method of presentation of these lists was shown to have significant effects on word learning and retention, such knowledge would contribute to our understanding of factors which contribute to successful beginning reading. Such knowledge may also contribute to our understanding of the processes used by beginning readers in learning to read words.
The results of this study were not generalizable beyond the population tested nor beyond the conditions of the experiment. Degree of learning and degree of similarity were variables that were uncontrolled. Their effects on acquisition, retention, cue selection, and transfer in this experiment were not tested.

The remainder of this study includes a review of the related literature, methods used to conduct the experiment, the results, and a discussion of the results. Chapter II includes a review of theory and experimental studies which have examined acquisition of similar materials, cue selection, mediated transfer, and proactive interference. Chapter III includes definitions, method of subject and material selection, the word lists, and a statement of hypotheses and method of data analysis. Chapter IV includes the analysis of data. Chapter V summarizes and interprets the results of this study.
CHAPTER II

REVIEW OF LITERATURE

This chapter will review theory and research concerned with factors which are of interest to this study. Those variables are learning similar materials by the use of the paired-associate technique, cue selection, mediated transfer, and proactive interference.

In each of the three treatment groups, different processes are hypothesized to cause the effects. For example, the effects of intra-list similarity and cue selection are centrally important to the acquisition of the minimal contrast lists. Mediated transfer is centrally important to the acquisition of the systematic contrast group. Proactive interference is important to the retention of all groups. The random similarity group is included as a reference group so that the effects of the different similarity relationships of the other groups can be assessed.

Similarity relationships are centrally important to each of the psychological processes investigated in this study. Types of similarity vary. Psychologists study the effects of semantic, conceptual, associative, acoustic, or formal similarity. This study was designed to assess the
effects of formal similarity and acoustic similarity.

Formal similarity is defined as the number of common environmental properties (Hall, 1971, p. 131). In this case the properties include the number and position of identical letters between words. Formal similarity is a property of the written words which serve as stimuli in this study. The second type of similarity is acoustic similarity. It is defined as the number and position of identical phonemes between words. Acoustic similarity is a property of the oral pronunciation of the stimulus words. The nature of the paired-associate task and the sight words employed in this study demanded that formal and acoustic similarity be studied concurrently. It is also necessary to make a distinction between stimulus properties and response properties, as each, when studied independently, may contribute to differential effects. In this study the effects of each are not included as part of the design and cannot be studied independently. The effects are caused by a combination of formal and acoustic similarity.

Learning and Similarity Relationships

Most investigators have found that both stimulus and response similarity inhibit paired-associate learning. However, the similarity variable appears to be more potent when it is on the stimulus rather than the response side of the pair. When two or more related stimulus components are
incorporated in the same paired-associate list, there is a pronounced tendency, especially in the early acquisition trials, for one stimulus to evoke the response that is becoming associated with a related stimulus (Kausler, 1966, p. 224). The tendency to evoke the inappropriate response diminishes as the similarity between the related stimuli decrease. Response components may also vary in their similarity. If paired-associate learning is analyzed in terms of a response learning and associative phase, it has generally been found that response learning is facilitated, while the associative stage is inhibited (Hall, 1971, p. 171). This means that similar responses can be learned more easily than they can be associated with their respective stimuli.

The previous conclusions led to the hypotheses concerning acquisition of minimal contrast lists. A typical minimal contrast list consists of the stimulus words "hand," "land," "band," and "sand." Each word has three identical letters, therefore, learning should be inhibited. However, the phonemic responses are also similar—/hand/, /land/, /band/, /sand/. Response learning should be facilitated. Assuming that the effects of stimulus similarity and response are of equal magnitude, the problem for the learner becomes one of associating the correct response with its stimulus. If the learner could detect a strategy to simplify the learning task (cue selection), learning minimal
contrast lists in which the discriminating cue was in an invariant position would be facilitated. In theory and research there is an abundance of literature about these variables.

In the early 1940's Eleanor Gibson (Gibson, 1940, 1942) attempted to formulate a comprehensive theory of verbal learning. Generalization and differentiation concepts were related to transfer, interference, intra-list effects, and retroactive inhibition. Similarity was made an important variable. The theory is an all-encompassing one. Only parts relevant to this study will be discussed.

Gibson claimed that the major necessity of verbal learning is the establishment of discrimination among items to be learned. Discrimination is a fundamental part of the learning process. As similarity increases, differentiation becomes more difficult and learning takes longer. Generalization tendencies increase and must be extinguished by differentially reinforced correct responses. When discrimination does occur, learning time is reduced.

Similarity relationships also affect retention. Differentiation lapses over a period of time, thus allowing for spontaneous recovery of the generalized tendencies. As a result, retention should be adversely affected by intra-list similarity. Difficulty in retention should be proportional to the degree of original generalization (difficulty in learning) if time has been allowed for spontaneous recovery.
Part of the theory outlined relationships in transfer. Gibson felt positive transfer would occur in situations where the nature of the second task permitted discrimination acquired in the previous task to be successful. However, inter-list interference would occur in proportion to the strength of the first list items to generalize with second list items. Negative transfer would occur when generalization with a previous task occurs, but where the situation is such that discrimination between the two tasks themselves is required, as well as learning the second. In regard to negative transfer, Gibson postulated that stimulus items which generalize when presented for learning in a single list would do so when presented in two separate lists. Degree of learning and temporal factors were discussed. In general, higher degrees of learning would negate some of the difficulties in further learning, whereas time worked against the learner.

In reference to this study, Gibson's theory predicts more difficulty in learning, and less retention for the minimal contrast lists. No positive transfer for minimal contrast lists would occur unless the learner acquired and used a transferable strategy to permit rapid discrimination of items within a list. In regard to the systematic contrast lists, the theory predicts easier learning and better retention for the original list, but that these items would serve as a source of interference for learning subsequent
items. Learning subsequent random contrast lists would not be as inhibited by generalization tendencies because subsequent items are dissimilar.

Gibson's theory stimulated extensive research in verbal learning. Most studies employed adult subjects in a paired-associate task. Various materials were used as stimuli and responses. In addition to acquisition measures, retention measures were often made in the same experiment.

Gibson (1942) tested some elements of her own theory. Nonsense geometrical forms were used as stimuli. Gibson found that a group of twelve relatively dissimilar items required fewer trials to learn and had greater retention after twenty-four hours than did groups of twelve highly similar forms. She also found that fewer high similarity items were recalled even when given twice as many learning trials as low similarity items.

Gagne (1950) reviewed a series of studies which tested the Gibson theory. In general, he found that the greater degree of similarity of stimulus items, the slower the learning and the smaller the amount of retention. Gagne then tested a deduced consequence of the theory using geometric forms as stimuli. He reasoned that if items of greatest similarity occurred together, generalization would occur early in the learning. Errors would be concentrated at the beginning of the learning task then would rapidly decrease. Learning would be more efficient than if similar
items were spaced throughout the learning task. Gagne felt
that presenting similar items together provided more oppor­
tunity to learn the cue relevant to the response than a
spaced presentation of similar items. The results of the
experiment supported Gagne’s thinking. Putting the emphasis
on similarity by grouping similar items led to more rapid
learning of the total set of material than a method which
emphasized sequential separation of similar items. For the
grouped similarity condition, errors were concentrated at
the beginning of the learning task then rapidly decreased,
whereas, errors were distributed throughout the task for
the sequentially spaced similar items.

Gagne’s experiment stimulated others to test the
effects of grouping similar stimuli together. Different
stimulus materials were used.

Rothkopf (1958) tested the general applicability of
Gagne’s conclusions by systematically manipulating the se­
quence of stimulus similarity. Morse Code signals were used
as stimuli. The effects at three levels of learning were
assessed. At all levels of learning, the condition in which
similar stimuli were separated led to more correct responses
than grouped similar stimuli. Rothkopf’s conclusions were
in direct opposition to those of Gagne. Rothkopf reasoned
that the nature of the stimulus materials was the differ­
entiating factor in this experiment. He felt that verbal
involvement was necessary. In the Gagne experiment,
subjects could verbalize about the materials, whereas, the Morse Code signals permitted no verbal involvement, thus no opportunity to mediate responses.

Rotberg and Woolman (1963) used nonsense syllables as stimuli in another test of Gagne's conclusions. Similarity was varied by the nonsense syllables having three of its four letters in common with the other syllables. Rotberg and Woolman found that when similar items were grouped together in a list, learning occurred more rapidly than when spaced apart. They concluded that discrimination was more likely to occur when similar items were adjacent. Thus Gagne's conclusions were supported.

The research evidence partially supported Gibson's theory. Similar materials were more difficult to learn and remember. Generalization and discrimination were factors which were involved in the learning task. However, when similar verbal materials were grouped together they were easier to learn than when spaced throughout the task. In the late 1950's the Gibson theory came under attack (Murdock, 1958), and was stoutly defended (Runquist, 1959). Underwood (1961) examined the evidence in support of the theory and found that parts were a valid explanation of the data, while other parts could be rejected.

Underwood (1961), after reviewing the research, concluded that the generalization part of the theory worked well for single list learning if total errors were counted
as the measure of generalization. However, he found no evidence of spontaneous recovery of generalization for retention measures. Underwood (1961) conducted his own experiments with a variety of materials and subjects and actually found some high similarity lists were better recalled than low similarity lists.

In reviewing the transfer components of the theory, Underwood felt that they had limited applicability because response similarity was not considered a component which influenced learning. Data to support the negative transfer aspect were inconsistent or had relied on non-verbal materials. However, Underwood stated that the transfer parts of the theory were probably correct if limited to inter-list similarity. Furthermore, the generalization tendencies between two lists appeared only for the initial learning trials of the second list. As learning the second list occurred, generalization decreased.

As a whole, Gibson's theory was rejected by Underwood. However, he did recognize the potency of intra-list and inter-list similarity relationships as variables influencing verbal learning. From the time Gibson published the theory until the present, verbal learning research has undergone changes. One of these is the distinction made between stimulus variables and response variables (Underwood and Schulz, 1960). Underwood (1961) suggested that Gibson's theory be extended to include response generalization. He
also stated that the transfer aspects of the theory could be better explained in terms of mediation theory rather than response generalization. Mediation theory will be discussed later in this chapter.

A series of experiments have examined stimulus and response similarity separately. Underwood (1953) found that the difficulty of learning increased with an increase in stimulus similarity but remained unchanged for variation in response similarity.

Feldman and Underwood (1957), Levitt and Goss (1961), Newman and Buckhout (1962), and Goss and Nodine (1965) found that high stimulus similarity items were more difficult to learn than low stimulus similarity items. For each experiment the effects of varying response similarity were less than varying stimulus similarity. In fact, Newman and Buckhout, and Goss and Nodine found an inverse relationship between response similarity and difficulty of response learning. Levitt and Goss suggested that response similarity facilitates response learning, but hinders the associative hookup with the stimulus. In conclusion, the net effect of increasing response similarity should have a less negative influence than should a comparable variation in stimulus similarity (Kausler, 1966, p. 227).

In this experiment response similarity is a variable in the learning task. Responses are also acoustic ones. A number of studies have investigated acoustic similarity in
paired-associate learning. Dale and Baddeley (1969) found no significant effect for acoustic similarity. Allen (1970) hypothesized that phoneme duplication would produce interference but letter duplication wouldn't. Her results were exactly opposite of what she expected. Letter duplication produced significantly more errors than did phoneme duplication.

Two studies examined the position of phonemic similarity on the stimulus side of the pair. Runquist (1970) constructed three lists of trigrams. For two lists the first two letters in the list were identical. However, one list had the same vowel; the other did not. The third list had only the first identical letter and served as a control. Results indicated that if two letters were identical and the vowel was different, the list could be learned as easily as the control list. However, if the vowels were identical, the list was more difficult to learn.

Nelson, Peebles, and Pancotto (1970) varied the position of identical letters, thereby varying the position of identical phonemes. Six-letter words were stimuli. Results indicated that a reduction in the distinctiveness of the initial portions, and to a lesser extent the terminal portions of words, increases the difficulty of acquisition to a greater extent than a reduction in the distinctiveness of the medial portion of the word.

The Dale and Allen studies indicate that phonemic
similarity in the response terms may have little effect on learning. The Runquist and Nelson studies indicate that phonemic similarity in the stimulus terms is a variable in learning and that the position of the similar phonemes within the experimental materials is also important.

In this experiment the position of the orthographic and phonemic similarity is a constant one. It is the first letter or first phoneme of the word. A series of experiments has investigated the effects of varying the position of the similarity.

Runquist conducted a series of experiments which explored the effects of varying the position of the identical elements in verbal materials. He found a variety of results. The amount of interference caused by high similarity was greatest when the locus of the identical elements was varied (Runquist, 1968, 1970a, 1971). High similarity in high meaningful material produced interference, but the location of identical elements had no effect (Runquist, 1970a, 1971). In low meaningful material a variable position for identical elements retarded learning (Runquist, 1970a). When position of the identical elements is a factor in learning, identity in the middle and last positions will be learned more easily than identity in the first and middle or first and last positions (Runquist, 1971). Conflicting evidence is reported by Thompson and Fritzler (1967) who found that identity of the first letters of the stimulus and response produced
more rapid acquisition than identity of the last letters of the stimulus and response terms. Runquist (1971) concluded that letter position is relevant if stimuli are analyzed into subunits and coded by selection. Finally, Runquist and Blackmore (1971) found that interference caused by identical elements in stimulus materials continued over repeated measures, although the magnitude of the effect decreases as subsequent materials were learned.

Another variable which may affect the learning of similar materials is the degree of meaningfulness that the materials possess. Underwood (1963) hypothesized an interaction between stimulus meaningfulness and formal stimulus similarity. He felt that increasing stimulus similarity should cause more difficulty in learning when the meaningfulness of materials is low than when it is high. Underwood reasoned that when materials have low meaningfulness they are not attended to as an integrated unit, but viewed as individual letters. When an item is meaningful, the subject perceives the item as an integrated unit.

Underwood's theory stimulated research. A variety of experimenters varied the meaningfulness of stimulus materials as they also varied formal similarity. Lockhart (1968) and Nelson (1968) found some support for Underwood's position. However, Lockhart found that when words were used as stimuli, similarity became an irrelevant variable. Nelson conducted several experiments with nonsense syllables. Results of
just one supported Underwood. The others found no interaction between meaningfulness and similarity. Highly similar materials were more difficult to learn than low similarity materials at any degree of meaningfulness. Further evidence against Underwood's position was supplied by Goss, Nodine, Gregory, Taub, and Kennedy (1962), Nodine (1963), and Goss and Nodine (1965).

Experimental work in the psychology of verbal learning has provided information about which variables and conditions of presentation affect learning. Similar experiments have been conducted to test the experimental results against the applied setting of reading instruction. The remaining review of research examines how reading researchers have studied the effects of similarity relationships on learning. Words were used as the materials of learning and relevant populations comprised the subjects.

King and Muehl (1965) compared the relative effectiveness of different cues and combinations of cues for word learning by kindergarten pupils. Similar and dissimilar words constituted another variable. For example, a group of similar words was: doll, ball, bowl, bell. A group of dissimilar words was: gate, drum, next, fork. Results indicated similar words were more difficult to learn. The authors concluded that with similar words an additional cue besides auditory was needed. King and Muehl also questioned whether it was the phonemic similarity of the words which
made them more difficult or the orthographic similarity.

Otto (1967) and Hartley (1970) used the paired-associate task to test the influence of type of cue on children's ability to learn similar or dissimilar words. Otto used second grade students and color cues. He found color cues had no effect but that low similarity words were more easily learned. Hartley used first grade students. Cues tested were graphemic alone, graphemic with picture, and graphemic with context clues. Stimulus words consisted of the minimal contrast and systematic contrast word types, the types used in this study. Hartley found no significant differences between learning minimal contrast and systematic contrast word lists. However, when interactions with cue type were examined, she found minimal contrast lists were learned significantly better when only a graphic cue was the stimulus.

In a departure from the paired-associate task, Jensen and King (1970) used 126 kindergarten children to test how methods of training affected learning similar and dissimilar words. Tracing, rearranging, and matching were the three methods of training. No significant differences were found in the initial experiment, but a replication with 60 kindergarten girls revealed that dissimilar words were easier to learn.

Two experiments examined the effects of discrimina-

bility of words on learning by kindergarten children. Both
used the paired-associate technique. Samuels and Jeffrey (1966) constructed lists of two letter words. The lists differed in discriminability in that either four, six, or eight letters were used to construct the four words. A separate group of students learned each list. Results indicated that the lists using more different letters were easiest to learn. McCutcheon and McDowell (1969) found the same results. Low similarity words were more easily learned than high similarity words. The authors of both experiments felt that students learned the dissimilar words on the basis of a single cue. Implications of these two studies will be discussed in the following section of this chapter.

Summary of Review of Similarity Relationships

Early theories of verbal learning recognized the importance of similarity relationships among the materials to be learned (Gibson, 1940). Experimental work has consistently demonstrated that low similarity materials are learned more easily than high similarity materials (Hall, 1971). However, when all the material to be learned is similar, massed presentation of similar items contributes to more rapid learning than spaced presentation (Gagne, 1950; Rotberg and Woolman, 1963). More recent theory makes a distinction between stimulus, response, and associative learning (Hall, 1971). High stimulus similarity is more difficult a condition than low stimulus similarity (Underwood,
1953; Feldman and Underwood, 1957; Levitt and Goss, 1961; Newman and Buckhout, 1962; Goss and Nodine, 1965; Runquist, 1968). Response similarity may have no effect (Underwood, 1953), or may facilitate response learning while inhibiting the associative hook-up between stimulus and response (Levitt and Goss, 1961; Newman and Buckhout, 1962). Position of identical letters between words is a factor in learning if stimuli are analyzed into subunits and coded by selection (Runquist, 1971). Interference caused by initial learning may be continued over subsequent learning although the magnitude of the effect decreases (Runquist, 1971a).

Meaningfulness has been suggested as a factor which affects learning of similar materials (Underwood, 1963). Lockhart (1968) and Nelson (1968) found that highly similar materials that were also high in meaning were learned more rapidly than low meaningful materials. However, contrasting evidence is provided by other experimenters (Goss, et al. 1962; Nodine, 1963; Goss and Nodine, 1965). Lockhart found that formal similarity became an irrelevant variable when words were used as stimuli. The present experiment uses high meaningful words as stimuli.

Reading experiments with beginning readers and meaningful reading materials have consistently demonstrated that high similarity materials are more difficult to learn than low similarity materials (King and Muehl, 1965; Samuels and Jeffrey, 1966; Otto, 1967; McCutcheon and McDowell, 1969;
Jensen and King, 1970). Hartley (1970) found no differences in learning due to similarity of words, but found an interaction between list type and cue. Minimal contrast words were more easily learned when only a graphic cue served as the stimulus.

The present study seeks to test the effect of similarity relationships under repeated measures. The position of the identical letters remains invariant. One letter and one phoneme, the first, is the variable one. With high similarity materials the subject is likely to be forced to rely on more precise elements of the nominal stimulus for use as a discriminable functional stimulus. High stimulus similarity should demand finer cue discriminations and demand more practice to learn (Kausler, 1966, p. 227). However, if the learner adopts a strategy to help make the discrimination easier, learning should be more rapid. One particular strategy might be cue selection. The next section of this chapter will review theory and research concerning cue selection.

Cue Selection

Initially, learning to read words is a complex task. Students must examine the written word and associate it with a meaningful response. The process involves stimulus learning, response learning, and the associative hook-up between stimulus and response (Anderson and Dearborn, 1952; Underwood
and Schulz, 1960). In reading, response learning is usually not a problem because meanings of the words are already known by the reader. Thus, the problem centers around stimulus learning and the associative hook-up. Often the reader attempts to reduce the complexity of the learning task by selecting stimulus elements that provide a stable cue which aids in differentiating among other stimuli that make up the material to be learned and which provide for the most efficient association with the response (Hall, 1971, p. 233).

Cue selection in beginning reading has generally been regarded as a thing to be avoided. Experimenters have cautioned that cue selection leads to initial rapid learning, but contributes to confusion in subsequent learning (Samuels and Jeffrey, 1966; McCutcheon and McDowell, 1969). Samuels and Jeffrey, and McCutcheon and McDowell thought that cue selection occurred with materials that were highly dissimilar, such as traditional beginning reading texts. Jeffrey and Samuels (1967) suggested that it is important to get children to attend to all the letters. This could be done by giving specific letter training or giving lists of highly similar words. Then identification would occur on the basis of more than a single stimulus feature.

This experiment examined cue selection in relation to the list types that children learn. In contrast to the suggestion of Jeffrey and Samuels, it was the contention of this study that lists of highly similar words would foster more
cue selection than lists of dissimilar words. Furthermore, it was predicted that cue selection would develop into a strategy of attack, a type of general transfer, with repeated contact with similar materials. Implications will be discussed in Chapter V.

The remainder of this section will review experimental research in psychology and reading which is related to cue selection. All experimental psychology studies cited used the paired-associate technique with adult subjects. Reading research cited used a variety of techniques with children as subjects. Stimulus materials for the studies varied.

In the experimental analysis of association, the specification of units linked through practice is a necessary first step. Historically, experimenters assumed that the stimulus defined by the experimenter was also the one used by the subject. In other words, the nominal stimulus was assumed to be the functional one (Postman and Keppel, 1969, p. 16). Hull felt that under most circumstances there was a close approximation to a one to one correspondence between the physical and functional stimulus (Hull, 1943, p. 112). The same assumption was made by most investigators of verbal learning, although the importance of the context of the stimulus was recognized.

However, the learner may make a functional stimulus out of all or any part of the nominal one. The process came under investigation more thoroughly after a distinction was
made between stimulus, response, and associative learning (McGuire, 1961). Underwood reported how a student of his first noted stimulus selection (Underwood, 1963a). Mattocks used trigrams as stimulus terms and words as responses. After the experiment he asked the subjects how they had formed the associations. Sixty-two per cent of the subjects said they had used the first letter of the trigram as the functional stimulus.

A replication study by Jenkins (1963) confirmed Mattocks' findings. Jenkins used trigrams as stimuli and digits as responses. After subjects had completed the learning task Jenkins divided the stimuli into three groups according to position. Then single letters were presented one at a time and subjects were asked to recall the response. Recall of responses was highest for the first letter of the stimulus and lowest for the middle. A conclusion drawn from Mattocks' and Jenkins' studies was that any element which is unique to a given stimulus and defines a stable cue for eliciting a response can be selected (Postman and Keppel, 1969, p. 18).

A variety of experiments have investigated stimulus selection as it is related to meaningfulness of the learning materials. When compound stimuli are presented, subjects usually select the most meaningful part as the cue (Underwood, Ham, and Ekstrand, 1962; Cohen and Musgrave, 1964; Houston, 1967). In addition, Cohen and Musgrave found that
when all parts of the stimulus were high in meaningfulness, there was no tendency to select a cue. Houston (1967) found that subjects selected elements which they had previous experience with in the experimental situation.

Postman and Greenbloom (1967) used easy and difficult to pronounce trigrams as stimuli. Digits were responses. Results indicated that there was little evidence for single letter cue selection when the stimulus terms were easy to pronounce. When stimuli were difficult to pronounce, subjects used the first letter as the functional stimulus. Lovelace and Blass (1968) found similar results. In their discussion of the results Postman and Greenbloom concluded that single letter cue selection is much more likely to occur when the nominal stimulus is poorly integrated than when it is a readily pronounceable unit. When a stimulus term is viewed as composed of discrete units, then selection is likely to occur. The first element is usually the favored one.

Other studies have investigated how degree of learning is related to stimulus selection. James and Greeno (1967) used a word and trigram as a double stimulus, and digits as responses. Three groups of subjects were given different amounts of practice. One group received trials until half of the list had been learned; another group received trials until all the list was learned; a third group learned the whole list, then received ten more trials. Results indicated
that stimulus selection occurred until the list was mastered, then selection relaxed as more cues became incorporated into the functional stimulus. Results were confirmed by Davis, Brown, and Ritchie (1968) and Wichawut and Martin (1970).

However, the interaction of degree of learning and stimulus selection has not always been a consistent one. The second part of the Davis, Brown, and Ritchie study failed to demonstrate the interaction. Also, Lovelace and Blass (1968) found no systematic improvement in the ability of subjects to utilize the second or third positions of stimulus materials as effective stimuli when higher degrees of learning were provided.

The relationship of similarity of materials and stimulus selection has also been investigated. Davis, Brown, and Ritchie found more cue selection with low than high similarity responses. Furthermore, additional practice beyond the criterion level of learning produced more selection with high than low response similarity. Weiss and Margolius (1954) found that subjects exposed to a stimulus composed of redundant elements may respond selectively to one of the elements. Designation of one of the components as the nominal stimulus would not prevent selection as long as the components were perfectly redundant. Cohen and Musgrave (1966) found that components with low inter-item similarity were favored in the selection process. Harrington (1969) concluded that the selection strategy involved an aspect of the
nominal stimulus that was consistently available throughout the learning task.

Finally, a study by Richardson and Chisholm (1969) demonstrated the transfer effect of stimulus selection in learning. In an original list, two letters were identical for all stimuli. Subjects were forced to learn on the basis of a single different letter in a variable position in each trigram. In the second list no letters were alike in the stimulus, but the subjects learned the list using the same strategy as was necessary to learn the first list. Variable letter positions were selected as cues.

In experimental psychology, stimulus selection has been extensively investigated. Subjects select part of the stimulus element to reduce the complexity of the learning task. Stimulus selection also helps the subject in differentiating among the other stimuli that make up the material to be learned. Meaningfulness, pronunciability, similarity of materials, and degree of learning are related to the stimulus selection process.

Degree of learning and similarity of materials are perhaps the factors important to this study. All stimulus materials are assumed to be equated for meaningfulness and pronunciability. In the minimal contrast group the locus of the differentiating cue is in an invariable position—the first. In the other groups, stimulus materials can be differentiated by a number of positions. The logic behind the
hypothesis that cue selection would be greater in the minimal contrast group is that the naive beginning reader views a written word as a compound stimuli, the letters comprising the parts. Selection should be minimal at first, but as the student finds he must discriminate the words on the basis of a single letter, more selection should occur. The strategy would be reinforced by contact with successive word lists which also must be learned on the basis of a single discriminating feature. A confounding factor is degree of learning. As words already learned continue to be presented in additional trials, the student may turn his attention to the remaining elements and integrate the stimulus or establish associations between the remaining letters and the responses (Hall, 1971, p. 235).

Cues used to recognize words have been extensively investigated in reading research. It has been suggested that children recognize words as wholes (Cattell, 1886) by geometric shape, outline or configuration (Bell, 1936; Tinker and Patterson, 1940), by familiarity with phoneme-grapheme correspondence (Gibson, 1962), by dominant letters such as ascenders and descenders (Wilson and Fleming, 1938), by initial and terminal letters (Levin and Watson, 1963; Wiley, 1928), by combinations of cues (Davidson, 1931; Gates and Boekker, 1923), and by discriminating features (Smith, 1971). Many of the studies used adult subjects and the tachistoscope. The cues used by children may be different from
those used by adults, and word recognition in normal reading may be different from recognition in tachistoscopic studies.

Samuels (1970) attempted to summarize and clarify the word recognition controversy. He stated that the beginning reader may select any cue to discriminate a word from others. Cues could be a single letter, a letter group, word shape, length, or any characteristic of the word which sets it off from others. To retain a word in his reading vocabulary, the reader must be able to recognize the distinguishing cue, have the correct response available, and make the correct association between cue and response. Samuels suggested that each individual selected the cue which was personally easiest to recognize and remember.

This study hypothesized that in the minimal contrast group students would select the first letter as the cue to learn the oral response to the written word. There is plenty of evidence to suggest that the initial letter of a word is a powerful cue for the beginning reader. Most studies indicate that the initial and final letters of the word receive the most attention by the beginning reader (Gates and Boeker, 1923; Meek, 1925; Wiley, 1928; Hill, 1936; Levin and Watson, 1963; Edelman, 1963; Marchbanks and Levin, 1965). Comparisons of cues used by good and poor readers have indicated that the last letter might be the more potent cue for poor readers while the first letter
might be more potent for good readers (Crosland, 1939; LaGrone, 1942).

This study used a sample of kindergarten children. Some studies have examined cues used by kindergarten children who learn to read a few words in an experimental situation. Edelman (1963) found that kindergarten boys used the last letter as the most important cue. Marchbanks and Levin (1965) found identical results. Williams, Blumberg, and Williams (1970) replicated the Marchbanks and Levin study on low socio-economic status kindergarten students who were unfamiliar with the alphabet. They found that the kindergarten pupils showed no consistent cue selections.

The Williams, et al., and Marchbanks and Levin studies used the tachistoscope to determine which cues the children employed. Exposure to the words was brief, and the children did not learn to read the stimulus words. The present study sought to assess the influence of similarity relationships on the children's ability to recognize words on the basis of the first letter when the students had an opportunity to view and study the words through repeated presentations in the paired-associate task.

Summary of Cue Selection

Cue selection is a process of isolating part of a nominal stimulus to use as a functional stimulus. Cue selection is a method by which a learner simplifies the learning task. It helps the learner discriminate among stimuli in the

In reading methodology, cues used to recognize words have been extensively investigated (Samuels, 1970). The current popular opinion is that the beginning reader uses the cue which is personally easiest for him to recognize (Samuels, 1970). Cue selection in beginning reading is generally regarded as something to be avoided (Samuels and Jeffrey, 1966; McCutchen and McDowell, 1969). In less naive students, the first letter of the word is generally the most powerful cue (Marchbanks and Levin, 1965) whereas students with no previous reading skill show no preference (Williams, et al. 1970).

This study examined the ability of students with no previous reading experience to recognize a word using only the first letter as a cue. Stimulus materials varied in degree and position of formal similarity. It was
that more cue selection would occur in students who must learn minimal contrast lists, as the words within each list must be discriminated on the basis of the first letter only. Furthermore, a general strategy of learning by cue selection should have developed in students who learned successive minimal contrast lists.

Review of Transfer Literature

The study of transfer is concerned with the influence of prior practice upon performance in a new learning task. Transfer is not a gross phenomenon. Postman and Keppel (1969, p. 263) describe two kinds of transfer. They are: 1) general transfer and 2) specific transfer.

General transfer consists of generalizable habits and skills which are independent of specific similarity relations among tasks. Its effects are generally positive. "Learning to learn" is a kind of general transfer. "Learning to learn" may involve a change in the subject's mode of attack on a problem or may be just the habits and skills which are carried over from one task to another (Postman and Keppel, 1969, p. 264).

Specific transfer depends on knowledge of similarity relations between the components of successive learning tasks. For example, specific transfer can be considered a factor when a second group of words is learned after a first group has been acquired. Specific transfer will be either a cause
of interference or facilitation in learning the second group of words. The similarity relations between the two groups determines the nature of the transfer. Positive transfer is a condition in which subsequent learning is facilitated. Negative transfer is a condition in which subsequent learning is inhibited.

General and specific transfer operate together so that it is often difficult to determine how each component contributes to successive learning tasks. The net transfer effect may be viewed as the algebraic summation of the effects of the separate mechanisms (Kausler, 1966, p. 367).

General and specific transfer are important to this study. All three treatment groups received repeated learning tasks. A general increment in learning would be expected on the basis of practice alone—a kind of general transfer. For naive subjects, familiarization with the learning task is important. However, the major portion of the habits and skills responsible for the gains in performance is acquired rapidly, and protracted training yields diminishing returns (Postman and Keppel, 1969, p. 266). This study attempts to separate the effects of practice from specific transfer by including in the analysis of data a treatment group which is free from the effects caused by specific transfer. This group is the randomized similarity group. The minimal and systematic groups will be compared to it.

A type of general transfer was hypothesized for the
minimal contrast group. Experience with a list of words which differ only on the basis of their first letters may cause the learner to rely on that sole discriminating feature as the cue to learn the word. Such a strategy may become generalized and transfer to a new learning task. Repeated exposure to other word lists of the same type may reinforce this strategy of word learning. The cue selection test given on the first and last days of the experiment determined if the strategy was employed and if it became the preponderant cue for learning.

A type of specific transfer was hypothesized for the systematic contrast group. Successive word lists bear a systematic similarity to prior word lists. For example, the transfer paradigm might be diagrammed:

<table>
<thead>
<tr>
<th>List</th>
<th>刺激</th>
<th>反应</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A - B</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A' - B'</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A'' - B''</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>A''' - B'''</td>
<td></td>
</tr>
</tbody>
</table>

All the stimulus terms (A) were orthographically similar, differing only on the basis of the first letter. All the response terms (B) are similar, differing only on the basis of the first phoneme. There is some reason to believe that learning subsequent lists will be facilitated by the similarity relationships between lists.

A review of research literature pertaining to general and specific transfer supports some of the hypotheses concerning acquisition of the minimal and systematic contrast word lists.
Rapid learning of the minimal contrast lists was predicted. It was hypothesized that subjects would discover a method of recognizing words on the basis of the first letter and that this method would transfer to learning new word lists of the same type. Postman and Schwartz (1964) found that the method of practice used in a first task consistently influenced subsequent learning more than the class of verbal materials. Postman and Schwartz concluded that inter-list effects are based in part on specific instrumental habits which are carried over from one task to another.

Postman (1964) and Keppel and Postman (1966) conducted experiments investigating mediated transfer with associative similarity materials; however, they also drew conclusions about the subjects' method of attack on successive tasks. They found that experience with transfer situations enhanced a learner's ability to recognize similarity relationships between successive tasks and to develop strategies of responding which facilitate subsequent learning and minimizes interference.

Two other experiments indicate that a strategy of learning is transferable. Richardson and Chisholm (1969) had undergraduate subjects learn two paired-associate lists. In the first list, two of the three letters of each word were identical for all stimuli. Subjects were forced to learn the list using a single letter cue. No letters were identical in the second list, but subjects learned it using a
single letter cue for each trigram. Kausler and Farzanegan (1969) also used undergrads to investigate selection strategies. They also found that a strategy established for learning the first list also transferred to learning the second list. Predictions about acquisition of successive systematic contrast lists draw on the literature concerned with specific transfer.

The Gibson theory (Gibson, 1940) made predictions about the effects of similarity relations on transfer. Gibson felt that positive transfer would occur in situations in which discrimination acquired in the first task could be used in the second task. However, negative transfer would result to the degree that second list items generalized with the first list items. Gibson's rationale was that items which would generalize when presented for learning in a single list would also do so in separate lists. As applied to acquisition of subsequent systematic contrast lists, Gibson's theory predicts negative transfer because subsequent items are similar to prior items, and generalization would occur.

Osgood (1949) refined a theory of transfer which considered stimulus and response terms separately. Recall that systematic contrast lists have both stimulus and response similarity between lists. According to Osgood's Transfer Surface such a condition should result in a very mild negative transfer, or no transfer at all. Most of the research on the Osgood theory has used associative similarity
materials. The research has generally supported the theory (Bugelski and Cadwallader, 1956; Dallett, 1962; Wimer, 1964).

Osgood's surface predicts diminishing negative transfer as the responses of List Two change from neutrality to increasing degrees of similarity. At some unspecified degree of similarity transfer begins to shift from negative to positive. Similarity can also exist on the stimulus side of the pair. This condition is represented by the paradigm $A - B, A'B$. The transfer surface predicts increasing positive transfer as the similarity of related stimuli increases.

In more recent times explanations of transfer have been explained in terms of mediational processes. For example, in two lists represented by $A - B, A - B'$, in which the response terms are similar, positive transfer is predicted. The rationale is that after $B$ is learned it serves as a link to elicit $B'$ when the second list is learned. Therefore, if $B$ elicits $B'$ it cannot serve as a source of interference.

Mediation may occur with or without awareness. Bugelski and Scharlock (1952), Russell and Storms (1955), Mednick and Freedman (1960), and Horton and Kjeldergaard (1961) found evidence of mediation without awareness. Lee and Jensen (1968) found that awareness facilitated acquisition more than nonawareness. Interview data from Lee and Jensen experiment also showed that subjects who became aware of mediation on their own did better on the transfer task than
others who did not become aware. Mediation by kindergarten children has also been demonstrated (Norcross and Spiker, 1958; Kausler and Deichmann, 1968).

Most studies have used associative similarity materials to measure the transfer. A few have used orthographic or phonemic similarity. Richardson (1967) found significant amounts of positive transfer in the A - B, A - B' paradigm. Runquist (1969) and Warren (1969) found positive transfer in the A - B, A' - B paradigm. Runquist suggested that mediational mechanisms in transfer may also apply to formal similarity. McGlaughlin and Dale (1971) found significant positive transfer for stimuli which were acoustically related, but not for visually or formally related stimuli.

This study sought to determine the degree and nature of transfer in a condition in which stimulus and response terms are similar (A - B, A' - B'). The verbal materials of this study were orthographically similar on the stimulus side and phonemically similar on the response side. Positive transfer was predicted for the systematic contrast group. Finally, this study used a naive population, one not as skilled in verbal materials as the adult populations of most other transfer studies.

In word attack methodology, a different approach to transfer is taken. Transfer is usually considered as the ability to put component skills together to identify a new word. For example, the child learns the words "cat" and
"pet" then is expected to transfer his knowledge of letter-sound relationships to identify "Pat" when he sees it.

The type of transfer in this study is more akin to the type found in verbal learning experiments. After learning a first task, change in the ability to learn a second task is considered evidence of transfer. No instruction is given in combining component skills learned in the first task to facilitate learning the second. Several studies in reading methodology have examined this kind of transfer.

Samuels and Jeffrey (1966) examined kindergarten children's learning of highly discriminable as opposed to learning low discriminable lists. The children learned the highly discriminable list faster but used single letters as cues. However, the group given the highly discriminable list did less well in learning a second list which changed one letter of each of the original words.

Hartley (1970) had first grade children learn four minimal or maximal (systematic) contrast lists on four successive days. Her primary interest in transfer was the type traditionally considered in reading methodology. However, in her discussion of the daily learning curves, she noted that the performance on the minimal contrast lists was generally slightly better than performance on the maximal (systematic) lists. She stated that the daily differences were small (p. 111). No analysis of the List Type X Successive Lists interaction is given. The present study uses
a mixed design analysis of variance which permits an analysis of List Type X Successive Lists interaction.

**Summary of Transfer Literature**

Transfer may be categorized into two types—general and specific (Postman and Keppel, 1969). The net transfer effect may be viewed as a summation of the effects of general and specific transfer (Kausler, 1966). General transfer is usually a positive force, whereas, specific transfer may be positive or negative depending upon the similarity relations between tasks.

A type of general transfer was hypothesized for the minimal contrast group. It was predicted that subjects would learn on the basis of a single letter cue and that this strategy will transfer to similar tasks. Evidence from other experiments indicates that a learning method can transfer to successive tasks (Postman and Schwartz, 1964; Postman, 1964; Keppel and Postman, 1966; Richardson and Chisholm, 1969; Kausler and Farzanegan, 1969).

Positive transfer was predicted for the systematic contrast group. Traditional theories of transfer predict negative or no transfer (Gibson, 1950; Osgood, 1949). It is possible that mediated transfer may facilitate acquisition of subsequent word lists. Facilitation has been demonstrated with associative similarity materials. A few studies have suggested that mediated transfer might occur with orthographically similar materials (Runquist, 1969;

This study tested the effects of formal similarity upon transfer. Comparisons of performance for successive learning tasks enable an estimation of transfer. Processes known to operate on adult subjects learning associatively similar materials have been hypothesized to operate on kindergarten children learning formally similar materials. No instruction about the similarity relationships was given to the children.

Review of Retention Literature

In this study all students received a twenty-four hour retention test on words learned the previous day. The paradigm for the retention test is a proactive one. In the proactive interference paradigm a subject learns A, then B, then after some specified time, is tested for retention of B. The assumption is that A interferes with retention of B. Postman and Keppel (1969) state that interference in recall is closely tied to negative transfer in acquisition, so that the kind of similarity relations which inhibit learning would
also inhibit retention. Likewise, relationships which facilitate learning should facilitate retention.

Retention is influenced by a variety of factors. McGeoch and Irion (1952, p. 355) list:

1. Conditions in which retention is measured
2. Conditions in which original learning took place
3. Conditions which have prevailed between the time of learning and later recall
4. Various organic and psychological states of the retaining individual

Kausler (1966, p. 472), in reviewing the factors at work in the interference theory of forgetting, stated that response competition and unlearning are responsible for forgetting. He also stated that loss of list differentiation and spontaneous recovery of unlearned associations affect retention. Postman (1961) listed other factors which influence retention. They include:

1. Effects of stimulus and response dimensions
2. Effects of cues for recall
3. Effects of affective characteristics of materials
4. Degree of original learning
5. Temporal factors

Empirical research has generally supported the interference theory of forgetting as it relates to proactive interference. To review, this theory states that we forget what we learn because of interference produced by prior learning experiences.

Underwood (1957) drew attention to the proactive interference theory of forgetting and offered empirical support for its validity. Underwood reviewed fourteen studies and found that the more lists that were learned, the more
forgetting that occurred. The correlation between number of lists learned and the amount of forgetting was +.94. Underwood also cited two studies which demonstrated that subjects naive to verbal learning experiments were less prone to forget (Underwood and Richardson, 1956; Postman and Rau, 1957).

Others have examined experimental evidence and concluded that there was a considerable amount of support for the interference theory of forgetting. Slamecka and Ceraso (1960) reviewed the literature from 1941 to 1959 and concluded that proactive interference is a positive function of degree or amount of prior learning. The subject continued to stimulated research and other more recent studies continue to support Underwood's position. Ihalainen (1968) and Alin (1968) found that the amount of proactive interference decreased when the time between tasks was increased.

On the basis of research investigating proactive interference some predictions were made about the results of this study. A general decrement in retention is predicted for all treatment groups. Retention of successive lists should be less than retention of previous lists. The time between the learning task and retention test is constant for all lists and for all groups. Remaining predictions about retention rely on the effect of the similarity relations of the groups.

The lowest retention was predicted for the minimal contrast group. Items within each list must be discriminated
on the basis of a single letter. Such items are most sus-
ceptible to loss of differentiation and response competition
at the time of recall (Gibson, 1942; Postman, 1961).

The predictions about retention of the systematic con-
trast lists rely on a less consistent body of research.
The systematic contrast lists have inter-list stimulus and
response similarity. Experiments using a variety of experi-
mental techniques and materials indicate that proactive
interference is a positive function of stimulus similarity
(Melton and VonLackum, 1941; Bugelski, 1942; Underwood,
1944). However, no effect was found for response similarity
(Underwood, 1953; Young, 1955); or proactive interference
decreased with increasing response similarity (McGeoch and

Several studies used the kind of materials that the
present study employs. Heckelman and Spear (1967) examined
learning by children in grades four to six. The researchers
found that orthographic similarity facilitated recall better
than unrelated lists. Furthermore, they found the results
constant at each grade level. Bruce and Crowley (1969)
tested the effects of acoustic similarity on proactive inter-
ference after three time periods. They found no significant
differences due to degree of acoustic similarity on the recall
test. Hartley (1970) conducted an experiment similar to the
present one and found no differences in recall between min-
imal and systematic contrast lists. The majority of previous
experiments indicate that stimulus similarity should contribute to proactive interference, whereas response similarity may have no effect, or may facilitate retention.

The highest retention was predicted for the systematic contrast group. Postman and Keppel (1969) stated that interference in recall is closely tied to negative transfer in acquisition. Likewise, elements which contribute to positive transfer should facilitate retention. Postman (1961) reviews this issue in a discussion of associative similarity. In a review of the literature, Postman failed to find rises in proactive interference with increasing response similarity. He turned to an explanation which relies on mediation processes. Postman reasoned that in the A - B, A - B' paradigm, direct mediation provided additional practice on the first list during interpolated learning and also maintained the second list responses at high strength. Thus when transfer is positive, as in the mediational paradigms, proactive interference should be inhibited. As evidence, Postman and Stark (1964) found significant amount of proactive interference in an A - B, A - C paradigm, but not in the A - B, A - B' paradigm.

The present study was an adaptation of the A - B, A - B' paradigm, with orthographic and phonemic similarity substituted for associative similarity and an extension to include successive lists. This study also tested if the processes of proactive interference operate with naive
kindergarten children, that is, children who have no other words in their reading vocabularies. The effects of similarity relationships was assessed by comparison with retention of the random contrast lists.

Summary of Retention Literature

Retention is influenced by a variety of factors (McGeoch and Irion, 1952; Postman, 1961). Underwood (1957) hypothesized that forgetting is largely a function of material learned previously. Data support this view (Slamecka and Ceraso, 1960; Ihalainen, 1968; Alin, 1968). On this basis a general decrement in retention was hypothesized for all treatment groups as more lists are learned.

Similarity relations affect retention. Stimulus similarity inhibits retention whereas response similarity may have no effect, or may decrease proactive similarity. Results using children subjects and orthographic or acoustic materials are inconclusive (Heckelman and Spear, 1967; Bruce and Crowley, 1969). One clear example of a proactive interference study in reading methodology found no significant differences due to similarity (Hartley, 1970).

This experiment tested the effects of similarity relations on retention. Effects of intra-list similarity were provided by the minimal contrast group. Mediated facilitation, found in adults learning associatively similar materials, was hypothesized for the systematic contrast groups.
This experiment provided further evidence about the validity of the proactive interference theory of forgetting as applied to children who have no prior knowledge of written words.
CHAPTER III

EXPERIMENTAL DESIGN

Subjects

An experimental population that had no previous reading instruction was desired. On this basis kindergarten children from Grove City, Ohio, schools were chosen. From a population of 67 kindergarten children, 36 were randomly selected to participate in the experiment. Subjects were then randomly assigned to the treatment groups. Students had received reading readiness training, but had no formal instruction in word identification. Before the experiment students were asked to read the words they were expected to learn. No student could read any of the words. However, all could read their names. The experiment was conducted the third week in March, 1972.

Twelve students were assigned to each treatment group. No subject received more than one treatment. Students who failed to participate in any part of the experiment because of absence from school had their scores removed from final analysis of the data. They were replaced by substitutes who had been randomly selected and assigned to a treatment group. There were two substitutes, one for the systematic contrast group and one for the random contrast group.
Definitions

1. Orthographic Similarity—a condition in which words have more than two common letters in their spellings

2. Phonemic Similarity—a condition in which words have more than two common phonemes in their oral pronunciation

3. Minimal Contrast—a condition in which the words within a list differ by only one grapheme and one phoneme

4. Systematic Contrast—a condition in which the words within a list differ by two or more graphemes and two or more phonemes; each subsequent list contains an item which is phonemically and orthographically similar to an item in the original list
   (For example:
   
   List 1 = Items A, B, C, D
   List 2 = Items A', B', C', D'
   List 3 = Items A'', B'', C'', D''
   List 4 = Items A''', B''', C''', D'''
   wherein A, A', A'', A''' differ by only one grapheme and one phoneme)

5. Random Contrast—a condition in which there is no systematic phonemic or orthographic similarity within or between lists

6. Stimulus Selection—a process in which a subject can give the correct oral response for a word when presented with only the first letter of the word as a stimulus

7. Acquisition—the ability of a subject to give the correct oral representation of a word when presented with its written representation

8. Transfer—the increment or decrement in learning subsequent lists which is attributable to the effects of learning prior lists

9. Retention—the ability of a subject to give the correct oral response upon presentation of the written word twenty-four hours after completion of the learning trials
Procedures

This experiment was designed to compare children's word learning and retention under three conditions of presentation with four repeated measures for each condition. Degree of stimulus selection for each condition was also compared. The dependent variables were acquisition, retention, and stimulus selection. Degree of transfer was inferred from acquisition measures taken on subsequent word lists. The independent variables were orthographic and phonemic similarity, which covaried, as well as the condition of repeated measures for each treatment group.

The three levels of orthographic and phonemic similarity were:
1. Minimal Contrast
2. Systematic Contrast
3. Random Contrast

The three levels of orthographic and phonemic similarity comprised the three treatment groups. Four word lists of each type of similarity were constructed. On each of four successive days each treatment group learned one of its assigned lists. The minimal contrast group learned four minimal contrast lists, one for each day of the experiment. The systematic contrast group learned four lists which bore a systematic phonemic and graphemic relationship to each other. The random contrast group learned four lists which had no systematic phonemic or graphemic relationship within or between each other.
Stimulus materials were printed in primer size type on unlined five by eight inch white index cards. There was one word per card. A modified study-test paired-associate technique was used to teach the words to the subjects. Stimuli were the words printed on cards. Responses were the oral pronunciation. The order of presentation of the words was randomized on each trial in order to eliminate serial learning effects (Deese, 1969).

A warm-up procedure was used the first day to acquaint subjects with the learning task. A warm-up task prepares subjects for the reception of relevant stimuli and leads to the adoption of the required rhythm of responding. A non-learning task such as color naming or number guessing may serve as a warm-up activity. For naïve subjects, familiarization with the learning task is important; however, the warm-up itself is not a major factor in producing improvement in the performance of verbal tasks (Postman and Keppel, 1969, p. 266). In this experiment the warm-up consisted of having each subject name three pictures which were mounted on five by eight inch index cards.

The components and order of the experiment are presented in Table 1.

On Day 1, students received the warm-up task to acquaint them with the procedures of the test. Then the students learned the assigned lists in the study-test paired-associate technique. Following the completion of fifteen learning
<table>
<thead>
<tr>
<th>Day</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>Warm-up</td>
</tr>
<tr>
<td></td>
<td>Study and Test Trials for List 1</td>
</tr>
<tr>
<td></td>
<td>Stimulus Selection Test for One-Half of the subjects for Each Treatment Group</td>
</tr>
<tr>
<td>Day 2</td>
<td>Retention Test for List 1</td>
</tr>
<tr>
<td></td>
<td>Study and Test Trials for List 2</td>
</tr>
<tr>
<td>Day 3</td>
<td>Retention Test for List 2</td>
</tr>
<tr>
<td></td>
<td>Study and Test Trials for List 3</td>
</tr>
<tr>
<td>Day 4</td>
<td>Retention Test for List 3</td>
</tr>
<tr>
<td></td>
<td>Study and Test Trials for List 4</td>
</tr>
<tr>
<td></td>
<td>Stimulus Selection Test for All Subjects in All Treatment Groups</td>
</tr>
</tbody>
</table>
trials, the cue selection test was administered to one-half of the students in each treatment group.

On Days 2, 3, and 4, subjects were given a retention test on the words learned the previous day. A retention test could not be given on the last list because some students did not start the experiment until Tuesday. They finished learning the last list on Friday and were unavailable for a twenty-four hour retention test on Saturday. Prior to learning the new word list, subjects were presented with the words learned the previous day and were asked to remember the correct oral response. The written words were presented singly. Experimenters gave no reply to the responses of the subjects. Retention time for each list within each treatment group was twenty-four hours. Each pupil learned a new list of words from his assigned treatment group after the retention test. On Day 4 all students in all treatment groups received the stimulus selection test.

The stimulus selection test consisted of presenting the first letter of a word to the subject and asking the subject to identify the word using only the first letter as a cue. The first letters were printed in primer type on five-by-eight inch index cards. The stimulus selection test was given after a two minute rest interval following completion of the learning trials.

This stimulus selection test is an adaptation of one suggested by Postman and Greenbloom (1967). Postman and
Greenbloom suggested that the subject be given the selected cue and asked for the response. If a correct response were given, the subject would also be required to state the remaining components of the stimulus. If the subject could not provide the remaining stimulus elements, stimulus selection could be inferred. If the remaining stimulus could be provided, then learning upon the basis of selected cues could not be inferred.

In this experiment, subjects were naive. Most did not know letter names, so they could not provide the remaining stimulus elements if asked to do so. Therefore, the present procedure was used with a realization of its limitations. Students who gave the correct response to the selected cue could have learned the word on the basis of a combination of all cues. The present cue selection test is an indication of a student's ability to give the correct response using only the first letter. Inferences about cue selection for this experiment were interpreted within the constraints imposed by the test.

The stimulus selection test was given to one-half of the subjects in each contrast group on the first day. No stimulus selection test was given on the second and third days. On the fourth day, all subjects were given the test. Selective testing was necessary to avoid sensitizing the subjects to using the first letter as a cue to learn subsequent words. Selective testing also permitted an assessment of the effect of the testing on stimulus selection.
The experiment was conducted in five consecutive days. Data was collected concurrently for each treatment group. Directions for administering the experiment were standard for all subjects and are given in the Appendix.

Stimulus Materials

Words high in meaning were desired. Numerous authorities have advocated the development of a sight vocabulary which is rich in meaning for the beginning reader (Anderson and Dearborn, 1952; Betts, 1957; Harris, 1970). A list of meaningful words was provided through the courtesy of Dr. Edgar Dale. Words selected for this study had to appear on A List of 1400 Words Known by 75% or More of First Grade Children in the Enrichment Program of the Columbus (Ohio) Public Schools (Dale and Schuh, 1971). Two exceptions, the words "land," and "jack," do not appear on this list, but do appear on the International Kindergarten Union List (Horn, 1928). The International Kindergarten Union List is an older list of words chosen because of the frequency with which they appear in the speech of children before they enter the first grade.

The Dale-Schuh List is a list of words known by first grade children. In establishing this list, a random sample of children was selected from all the first grade children in the Columbus, Ohio public schools. Personal interviews were conducted to ascertain whether or not words were known
by the children. The words included in the list were known by 75% or more of the children. The Dale-Schuh List was selected because the sample of children from which it was compiled was similar in age and geographical location to the sample of children selected for this study. The list also has the advantage of recency.

To avoid problems caused by different word form classes and length, only four-letter concrete nouns were used. For this study, a homogeneous selection of words was desired for the minimal and systematic contrast groups. The criteria selected provided five levels of homogeneity. In addition to high meaning, the other criteria were:

1. The words must be monosyllabic
2. The words must be nouns
3. The words must pattern in groups of four
4. There must be four letters per word.

The minimal contrast lists were formed by varying the first letter of the word and holding the remaining letters constant. This method is advocated by such linguists as Sofietti, Bloomfield, and Fries. Systematic contrast lists were formed by assigning one word from each minimal contrast list to each systematic contrast list. The random contrast list was formed by listing all four letter, monosyllable nouns on the Dale-Schuh List, then randomly selecting four words for each of the four random contrast lists.

Each list contained four words. Each treatment group learned a total of sixteen words for the entire experiment.
Phonemic representations were provided by *The Random House Dictionary of the English Language*, Random House, N.Y., 1969. The lists are given in Table 2.

**Collection of Data**

The experimenter and a graduate student in psychology collected data for all subjects. Measures were recorded for acquisition, retention, and stimulus selection. Assessment of transfer was made by comparing the differences between acquisition measures for different lists within each treatment group. Differences in transfer between treatment groups was made by comparing the minimal contrast group and systematic contrast group to the random contrast group. The following measures were made for each subject:

1. **Acquisition**—the number of correct responses in fifteen consecutive trials
2. **Retention**—the number of items which were given the correct responses when the stimulus word was presented twenty-four hours after completion of the learning trials
3. **Stimulus Selection**—the number of items which were given the correct response when presented with the first letter of the word two minutes after completion of the learning trials
4. **Transfer**—the difference between acquisition measures for different lists within and between treatment groups

**Hypotheses**

This experiment was designed to test the following hypotheses:

**H**₁: In the acquisition trials, the number of correct responses for each minimal contrast list should
Table 2: Word Lists

<table>
<thead>
<tr>
<th>Minimal Contrast</th>
<th>Systematic Contrast</th>
<th>Random Contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Representation</td>
<td>Representation</td>
<td>Representation</td>
</tr>
<tr>
<td>Graphemic/Phonemic*</td>
<td>Graphemic/Phonemic</td>
<td>Graphemic/Phonemic</td>
</tr>
</tbody>
</table>

**List 1**

1. back /bæk/  
2. pack /pak/  
3. sack /sæk/  
4. jack /jak/  

<table>
<thead>
<tr>
<th>Minimal Contrast</th>
<th>Systematic Contrast</th>
<th>Random Contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Representation</td>
<td>Representation</td>
<td>Representation</td>
</tr>
<tr>
<td>Graphemic/Phonemic*</td>
<td>Graphemic/Phonemic</td>
<td>Graphemic/Phonemic</td>
</tr>
</tbody>
</table>

**List 2**

1. hall /hɔl/  
2. wall /wɔl/  
3. ball /bɔl/  
4. fall /fɔl/  

**List 3**

1. jail /jɔl/  
2. nail /nɔl/  
3. pail /pɔl/  
4. tail /tɔl/  

**List 4**

1. land /land/  
2. hand /hand/  
3. band /band/  
4. sand /sand/  

*The Random House Dictionary of the English Language.*
be greater than the number of correct responses for systematic and random contrast lists.

\( H_2: \) On the retention tests, fewer minimal contrast items should be recognized than random or systematic contrast items.

\( H_3: \) On both cue selection tests, more minimal contrast items should be correctly identified than systematic or random contrast items.

\( H_4: \) More minimal contrast items should be correctly identified on the last cue selection test than on the first test.

\( H_5: \) In acquiring the first list of words, the number of correct responses for the systematic contrast group should equal the number of correct responses for the random contrast group.

\( H_6: \) In acquiring subsequent lists, the number of correct responses for the systematic contrast group should be greater than the number of correct responses for the random contrast group.

\( H_7: \) On the first retention test, the number of correct responses should be equal for the systematic and random contrast groups.

\( H_8: \) On subsequent retention tests, the number of correct responses should be greater for the systematic contrast group than for the random contrast group.

\( H_9: \) On both cue selection tests, the number of correct responses should be equal for the systematic and random contrast groups.

\( H_{10}: \) For the random and systematic contrast groups, the number of correct responses on the first cue selection test should equal the number of correct responses on the last cue selection test.

**Methods of Analysis**

All analyses of data were done by comparing scores using analysis of variance techniques. The level of
significance needed to reject the null hypotheses was set at $p < .05$.

To clarify data collection procedures and to demonstrate which scores were analyzed, a sample data matrix for acquisition scores is given in Table 3. The data matrix for retention scores is identical except that data for List 4 ($B^4$) is omitted.

For acquisition measures, the research hypotheses involved a comparison of the list scores of each contrast group. Using the notation of Table 3, the following comparisons were made for hypotheses concerning acquisition data.

\begin{align*}
H_1: & \quad A_2B_1 < A_1B_1 > A_3B_1 \\
     & \quad A_2B_2 < A_1B_2 > A_3B_2 \\
     & \quad A_2B_3 < A_1B_3 > A_3B_3 \\
     & \quad A_2B_4 < A_1B_4 > A_3B_4 \\
H_5: & \quad A_2B_1 = A_3B_1 \\
H_6: & \quad A_2B_2 > A_3B_2 \\
     & \quad A_2B_3 > A_3B_3 \\
     & \quad A_2B_4 > A_3B_4
\end{align*}

To simplify, $H_1$, $H_5$, and $H_6$ can be combined to read:

\begin{align*}
A_1B_1 & > A_2B_1 = A_3B_1 \\
A_1B_2 & > A_2B_2 > A_3B_2 \\
A_1B_3 & > A_2B_3 > A_3B_3 \\
A_1B_4 & > A_2B_4 > A_3B_4
\end{align*}
Table 3: Data Matrix for Acquisition (or Retention)

<table>
<thead>
<tr>
<th>Contract Group</th>
<th>List 1 $B_1$</th>
<th>List 2 $B_2$</th>
<th>List 3 $B_3$</th>
<th>List 4 $B_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_1$ (Minimal Contrast)</td>
<td>$A_1B_1$</td>
<td>$A_1B_2$</td>
<td>$A_1B_3$</td>
<td>$A_1B_4$</td>
</tr>
<tr>
<td>$A_2$ (Systematic Contrast)</td>
<td>$A_2B'_1$</td>
<td>$A_2B'_2$</td>
<td>$A_2B'_3$</td>
<td>$A_2B'_4$</td>
</tr>
<tr>
<td>$A_3$ (Random Contrast)</td>
<td>$A_3B''_1$</td>
<td>$A_3B''_2$</td>
<td>$A_3B''_3$</td>
<td>$A_3B''_4$</td>
</tr>
</tbody>
</table>
To analyze retention data identical procedures were used. Scores of the retention tests were entered in a data matrix similar to the matrix for acquisition scores. Using the notation of Table 3 the following comparisons were made concerning retention data.

\[H_2: A_2B_1 > A_1B_1 < A_3B_1\]
\[A_2B_2 > A_1B_2 < A_3B_2\]
\[A_2B_3 > A_1B_3 < A_3B_3\]

\[H_7: A_2B_1 = A_3B_1\]

\[H_8: A_2B_2 > A_3B_2\]
\[A_2B_3 > A_3B_3\]

To simplify, \(H_2\), \(H_7\), and \(H_8\) can be combined to read:

\[A_1B_1 < A_3B_1 = A_2B_1\]
\[A_1B_2 < A_3B_2 < A_2B_2\]
\[A_1B_3 < A_3B_3 < A_2B_3\]

Acquisition data and retention data were analyzed separately. A mixed design analysis of variance was run on acquisition and retention data to determine if there were any significant differences between or within treatment groups. The method of analysis is outlined by Lindquist (1953, p. 267). If differences were significant, Tukey's HSD procedure was used to locate which means were different (Kirk, 1968, p. 88).

Inferences about transfer were based on the outcome of comparisons with the randomized contrast group.
Comparison of list scores within treatment groups did not permit a true estimate of specific transfer. Comparison of scores with the random contrast group permitted the estimation of the effects of specific transfer. All groups were subject to general transfer. Thus, any differences between a specific treatment group and the random contrast group can be attributed to the effects of specific transfer.

To clarify analysis of the stimulus selection measures, a sample data matrix is given in Table 1.

A series of comparisons was made on cue selection data. Using the notation of Table 4, the following comparisons were made:

\[ H_3: A_2 < A_1 > A_3 \]
\[ H_4: A_1B_1 < A_1B_4 \]
\[ H_9: A_2 = A_3 \]
\[ H_{10}: A_2B_1 = A_2B_4 = A_3B_1 = A_3B_4 \]

To simplify, \( H_3 \) and \( H_4 \) can be combined to read:

\[ A_1 > A_2 = A_3 \]

Three statistical tests were used to test hypotheses about cue selection. On List 1, one-half the subjects in each treatment group were given the cue selection test. These same subjects were also given the cue selection test on List 4. Comparisons of cue selection between List 1 and List 4 were made by a mixed design repeated measures analysis of variance. This analysis also permitted comparison of List 1 scores between groups. To compare all
<table>
<thead>
<tr>
<th>Contrast Group</th>
<th>List 1 (B_1)</th>
<th>List 4 (B_4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A_1) (Minimal Contrast)</td>
<td>(A_1B_1 (1/2n))</td>
<td>(A_1B_4)</td>
</tr>
<tr>
<td>(A_2) (Systematic Contrast)</td>
<td>(A_2B_1 (1/2n))</td>
<td>(A_2B_4)</td>
</tr>
<tr>
<td>(A_3) (Random Contrast)</td>
<td>(A_3B_1 (1/2n))</td>
<td>(A_3B_4)</td>
</tr>
</tbody>
</table>
the scores on List 4, a one-way analysis of variance was used including all the scores in each treatment group. Finally, to determine if the cue selection test on List 1 sensitized subjects to learning by selecting the first letter, a two-way analysis of variance was used to compare the scores of those who were tested on List 1 with those who were not. The two-way analysis of variance was a 3x2 design with the treatment groups comprising one factor and List 1 testing the other factor. If necessary, post hoc tests were made by Tukey's HSD procedure.
CHAPTER IV

RESULTS

Cue Selection

Cue selection is centrally important to hypotheses about acquisition. Therefore, analysis of cue selection data is presented first. Three tests were made on cue selection data.

To determine if testing on List 1 sensitized subjects to learn by using the first letter, List 4 scores of subjects who were tested on List 1 were compared with List 4 scores of subjects who were not tested on List 1. A 3x2 analysis of variance was used. Results are summarized in Table 5. The means and standard deviations of List 4 scores are presented in Table 6. There were six subjects in each cell.

Results indicated that testing on List 1 had no significant effect on learning by cue selection in subsequent tasks. Since testing on List 1 had no effect on cue selection, data could be analyzed to test hypotheses. To test Hypotheses 3 and 9, List 4 scores were analyzed in a one-way analysis of variance. Results are summarized in Table 7. Means and standard deviations of the List 4 cue selection scores are given in Table 8. There were 12 subjects in each group.
<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrast Group</td>
<td>2</td>
<td>1.05</td>
<td>0.52</td>
<td>0.20</td>
</tr>
<tr>
<td>Testing</td>
<td>1</td>
<td>0.44</td>
<td>0.44</td>
<td>0.17</td>
</tr>
<tr>
<td>Contrast Group x Testing</td>
<td>2</td>
<td>3.38</td>
<td>1.69</td>
<td>0.64</td>
</tr>
<tr>
<td>Error</td>
<td>30</td>
<td>78.33</td>
<td>2.61</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>83.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6: Means and Standard Deviations of Contrast Group Testing on List 1 vs. No Testing on List 1

<table>
<thead>
<tr>
<th>Contrast Group</th>
<th>Tested on List 1</th>
<th>Not Tested on List 1</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Minimal</td>
<td>2.00</td>
<td>1.41</td>
<td>2.50</td>
</tr>
<tr>
<td>Systematic</td>
<td>2.16</td>
<td>1.34</td>
<td>2.00</td>
</tr>
<tr>
<td>Random</td>
<td>3.00</td>
<td>1.52</td>
<td>2.00</td>
</tr>
</tbody>
</table>
Table 7: Analysis of Variance for List 4 Cue Selection Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrast Group</td>
<td>2</td>
<td>1.05</td>
<td>0.527</td>
<td>0.21</td>
</tr>
<tr>
<td>Error</td>
<td>33</td>
<td>82.16</td>
<td>2.489</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>83.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Means and Standard Deviations of List 4 Cue Selection Scores

<table>
<thead>
<tr>
<th>Contrast Group</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal</td>
<td>2.25</td>
<td>1.53</td>
</tr>
<tr>
<td>Systematic</td>
<td>2.08</td>
<td>1.25</td>
</tr>
<tr>
<td>Random</td>
<td>2.50</td>
<td>1.70</td>
</tr>
</tbody>
</table>
Results of the one-way analysis of variance on List 4 cue selection scores indicated no significant differences between contrast groups. Results offer evidence to reject Hypothesis 3 and accept Hypothesis 9. That is, there is no greater cue selection in the minimal contrast group, and cue selection is equal in the systematic and random contrast groups.

Further evidence concerning Hypotheses 3 and 9 is provided by an analysis of variance which contrasts the List 1 and List 4 scores. Since the same subjects were tested on List 1 and 4, a mixed design repeated analysis of variance was used to examine the data. This analysis also provided a test of Hypotheses 4 and 10. Results of the analysis are presented in Table 9. Means and standard deviations of the List 1 and List 4 cue selection scores are given in Table 10. There were six subjects in each contrast group.

Results indicated no significant differences between contrast groups or within contrast groups. Results provide further evidence for rejecting Hypothesis 3 and accepting Hypothesis 9. Results also provide evidence for rejecting Hypothesis 4 and accepting Hypothesis 10. That is, there is no evidence to indicate that subjects in the minimal contrast condition adopted a strategy of learning by cue selection and used it to facilitate learning subsequent tasks. Cue selection was equal in the systematic and random contrast groups. Furthermore, no strategy of learning by cue selection
Table 9: Analysis of Variance for Cue Selection on Lists 1 and 4

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contrast Group</td>
<td>2</td>
<td>5.05</td>
<td>2.52</td>
<td>1.346</td>
</tr>
<tr>
<td>Subjects Within Contrast Group</td>
<td>15</td>
<td>28.16</td>
<td>1.87</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lists</td>
<td>1</td>
<td>0.44</td>
<td>0.44</td>
<td>0.147</td>
</tr>
<tr>
<td>Contrast Group X Lists</td>
<td>2</td>
<td>2.38</td>
<td>1.19</td>
<td>0.396</td>
</tr>
<tr>
<td>Error</td>
<td>15</td>
<td>45.16</td>
<td>3.01</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>81.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 10: Means and Standard Deviations of List 1 and List 4—Cue Selection Measures

<table>
<thead>
<tr>
<th>Contrast Group</th>
<th>List 1</th>
<th>List 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Minimal</td>
<td>2.50</td>
<td>1.11</td>
<td>2.00</td>
</tr>
<tr>
<td>Systematic</td>
<td>1.50</td>
<td>1.50</td>
<td>2.16</td>
</tr>
<tr>
<td>Random</td>
<td>2.50</td>
<td>1.60</td>
<td>3.00</td>
</tr>
</tbody>
</table>
developed in either the systematic or random contrast groups.

In summary, testing for cue selection had no significant effect on learning. Type of contrast in stimulus words had no significant effect on learning by cue selection. No strategy of learning by cue selection developed in any contrast group. Therefore, Hypotheses 8 and 10 were accepted, but interpretation is limited because of the failure to find significant differences between the minimal contrast group and the other contrast groups.

**Acquisition**

All acquisition data for all groups and all lists was included in a single mixed design analysis of variance. Results are presented in Table 11. Table 12 presents group means and standard deviations for acquisition data. There were twelve subjects in each contrast group.

Results of the analysis of variance indicate that there were no significant differences between contrast groups or between lists within contrast groups. No further analysis of acquisition data was undertaken. Hypotheses 1, 5, and 6 were rejected.

Examination of the means indicates that items in the minimal contrast condition were slightly more difficult to learn than items in the other conditions, a finding contrary to the one expected. Means for successive tasks are plotted in Figure 1. Further examination of the means indicates a
Table 11: Analysis of Variance for Acquisition Data

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contrast Group</td>
<td>2</td>
<td>2458.51</td>
<td>1229.25</td>
<td>1.87</td>
</tr>
<tr>
<td>Subjects Within Contrast Groups</td>
<td>33</td>
<td>21634.20</td>
<td>655.58</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Successive Lists</td>
<td>3</td>
<td>212.72</td>
<td>70.90</td>
<td>1.8</td>
</tr>
<tr>
<td>Contrast Group X Successive Lists</td>
<td>6</td>
<td>252.15</td>
<td>42.02</td>
<td>1.0</td>
</tr>
<tr>
<td>Error</td>
<td>99</td>
<td>3804.62</td>
<td>38.43</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td>28362.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 12: Group Means and Standard Deviations for Acquisition Data

<table>
<thead>
<tr>
<th>Group</th>
<th>List 1</th>
<th>List 2</th>
<th>List 3</th>
<th>List 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Minimal</td>
<td>34.83</td>
<td>13.64</td>
<td>37.91</td>
<td>15.60</td>
<td>34.00</td>
</tr>
<tr>
<td>Systematic</td>
<td>41.91</td>
<td>14.47</td>
<td>45.75</td>
<td>13.74</td>
<td>44.75</td>
</tr>
<tr>
<td>Random</td>
<td>45.00</td>
<td>9.82</td>
<td>42.66</td>
<td>11.98</td>
<td>46.58</td>
</tr>
<tr>
<td>Total</td>
<td>40.58</td>
<td>42.11</td>
<td>41.77</td>
<td>43.97</td>
<td>42.11</td>
</tr>
</tbody>
</table>
Figure 1: Means for Successive Lists
small increment in learning successive systematic and random lists, while the performance of the minimal contrast group is more erratic. Because no significant differences were found, interpretation of the acquisition data is necessarily limited.

Retention

All retention data for all groups and all lists were included in a single mixed design analysis of variance. Three retention measures were taken on each of the twelve subjects in each contrast group. Results are presented in Table 13. Group means and standard deviations for retention data are presented in Table 14 and plotted in Figure 2. There were twelve subjects in each contrast group.

Results of the analysis of variance reveal no significant differences between contrast groups between or within successive lists. There is a significant difference between lists when scores of the contrast groups are compared. The F value is 7.155. An $F_{(2,66)} > 3.15$ is needed for significance at $p < .05$ (Winer, 1971, p. 868). However, with the repeated measures analysis of variance, the F ratio is positively biased. Tukey's HSD procedure was used to compare differences between means. A difference of $0.941 (q 3,66)$ was needed for significance. No difference that large was found between any of the means. Therefore, there were no significant differences between retention of the lists when
Table 13: Analysis of Variance for Retention Data

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Between Subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contrast Group</td>
<td>2</td>
<td>12.05</td>
<td>6.02</td>
<td>1.68</td>
</tr>
<tr>
<td>Subjects Within Contrast Groups</td>
<td>33</td>
<td>118.19</td>
<td>3.58</td>
<td></td>
</tr>
<tr>
<td><strong>Within Subjects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Successive Lists</td>
<td>2</td>
<td>13.16</td>
<td>6.58</td>
<td>7.15**</td>
</tr>
<tr>
<td>Contrast Group X Successive List</td>
<td>4</td>
<td>2.77</td>
<td>0.69</td>
<td>0.75</td>
</tr>
<tr>
<td>Error</td>
<td>66</td>
<td>60.72</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>107</td>
<td>206.91</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**p < .01**
Figure 2: Group Means for Retention
<table>
<thead>
<tr>
<th>Group</th>
<th>List 1 M</th>
<th>List 1 SD</th>
<th>List 2 M</th>
<th>List 2 SD</th>
<th>List 3 M</th>
<th>List 3 SD</th>
<th>Total M</th>
<th>Total SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal</td>
<td>1.58</td>
<td>1.55</td>
<td>0.91</td>
<td>1.18</td>
<td>1.16</td>
<td>1.28</td>
<td>1.22</td>
<td></td>
</tr>
<tr>
<td>Systematic</td>
<td>2.41</td>
<td>1.11</td>
<td>1.91</td>
<td>1.44</td>
<td>1.50</td>
<td>1.32</td>
<td>1.94</td>
<td></td>
</tr>
<tr>
<td>Random</td>
<td>2.50</td>
<td>1.11</td>
<td>1.91</td>
<td>1.25</td>
<td>1.33</td>
<td>1.24</td>
<td>1.91</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2.16</td>
<td>1.58</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.33</td>
<td></td>
</tr>
</tbody>
</table>
the contrast groups' scores were combined.

An examination of the means in Table 14 and Figure 2 reveals a general decrement in retention for successive lists. The order of the contrast group means for successive lists is the order which was predicted. However, because no significant differences were found, further interpretation of the data is necessarily limited. In conclusion, Hypotheses 2, 7, and 8 were rejected.
CHAPTER V

DISCUSSION OF RESULTS

Introduction

Factors which affect acquisition, retention, and transfer in learning to read words are worthy of study. Traditionally, the semantic aspect of words has been considered important. Another factor which may influence acquisition, retention, and transfer is method of presenting words. This study examined three methods of presentation while controlling the orthographic, phonemic, and semantic characteristics of words.

Kindergarten subjects were randomly assigned to one of the three treatment groups. Then the subjects learned four word lists on four successive days. One group, the minimal contrast group, learned words which had a maximum amount of intra-list similarity. Words in the list differed by one grapheme and one phoneme. A second group, the systematic contrast group, learned word lists which had maximal inter-list similarity. For each item in a given list, there was a corresponding item in each of the other lists. Corresponding items differed by one grapheme and one phoneme. A third group, the random contrast group,
learned four lists which had no systematic intra-list or inter-list similarity. All words in all the lists were considered high in meaning for the sample of the population which was tested.

A modified paired-associate task was used to teach the words to the subjects. Acquisition measures were the number of items correctly responded to in fifteen trials. All subjects received a twenty-four hour retention test for the first three lists which were learned. Retention measures were the number of items correctly responded to when the stimulus word was presented twenty-four hours after completion of the learning trials. On the first and last lists, subjects were given a cue selection test to determine the power of the first letter of the word to elicit the correct response. Cue selection measures were the number of items correctly responded to when the first letter of the word was presented as a stimulus. Procedures for testing for cue selection also determined if there was an interaction between testing on List 1 and cue selection of List 4. There was no interaction.

For the minimal contrast group, rapid acquisition, but poor retention, were hypothesized. Also hypothesized for the minimal contrast group were greater amounts of cue selection and the development of a set for learning on the basis of a single discriminating letter. For the systematic
contrast group, it was predicted that positive transfer would facilitate a rapid acquisition of subsequent lists. It was also predicted that retention would be fostered by proactive facilitation. The random contrast group was included as a control group so that the similarity effects of the other contrast groups could be assessed against a general transfer effect which was hypothesized for all groups.

Each class of dependent variable was subjected to a separate mixed design analysis of variance (Lindquist, 1953, p. 267). Results of the analyses revealed no significant differences for any of the dependent variables.

Interpretation of the results is necessarily limited by the failure to find significant differences between or within groups for any of the dependent variables. Failure to find significant differences may have been due to the criterion of learning employed in this study. The number of correct responses for fifteen acquisition trials was the criterion. Within this criterion, any number of degrees of learning was possible. Contact with materials may have been stopped before the effects of orthographic characteristics or method of presentation had a chance to operate. Perhaps, carrying out learning to mastery of each list may have provided significant differences.

For example, the interaction between learning and cue selection may have influenced results (James and Groeno,
1967). In this experiment, the interaction could not be detected nor measured. Controlling the degree of learning by carrying out learning to mastery of the lists may have forced subjects to try alternative strategies of learning, one of which may have been cue selection. Transfer may also have been affected by degree of learning. The hypothesized mediated transfer may not have occurred because subjects did not learn items or lists well enough to use prior knowledge to facilitate learning new words. Finally, controlling the degree of learning may have provided significant differences in subject's ability to retain words. Retention is partially a product of how well items were learned. No exact comparison of retention between contrast groups is possible because of the variations in original learning that probably occurred.

Cue Selection

Cue selection measures were dependent upon the subject's ability to give the correct response when presented with only the first letter of the word. Results of this study indicated that even when the first letter is the only discriminating cue between words, children unfamiliar with the word recognition process selected this cue no more often than when learning words with many discriminating cues. This result extends the findings of Marchbanks and Levin (1965) and Williams, et al. (1970) that, with naive
students, the first letter cue is no more powerful than any other letter of the stimulus word.

Samuels and Jeffrey (1966) and McCutcheon and McDowell (1969) have cautioned that teaching words with gross perceptual differences may engender a tendency to learn words on the basis of a single cue. Samuels and Jeffrey stated that if a single letter cue led to rapid initial learning, a false economy would be realized. That is, initial learning would be rapid, but there would be no transfer for later learning. This study hypothesized that stimulus selection would occur with words which were maximally similar, and that learning of the minimal contrast lists would be more rapid because of the cue selection strategy. Results cannot be generalized to cues other than the first letter. However, the number of discriminating features between words made no difference in the power of the first letter to be selected as a cue. Furthermore subsequent minimal contrast lists were not learned more rapidly than the previous minimal control lists. There were no significant differences in specific or general transfer. It would seem, therefore, that subjects in the minimal contrast condition failed to detect a strategy of learning on the basis of a single discriminating letter cue. Stimulus selection of the first letter on the first list was equal to stimulus selection on the last list. Type of contrast, or number of discriminating features, between words made no difference in the power of the
first letter to be selected as a cue. Results do not support the contention of Samuels and Jeffrey and McCutcheon and McDowell that students would adopt a strategy of learning which impedes later learning.

It appeared that in learning the first list of words, subjects were free of any learning strategy which emphasized learning the words on the basis of the first letter cues. Comparisons of cue selection measures between groups revealed no significant differences. Therefore, one must assume that the degree of graphemic contrast was not a major factor contributing to the power of the first letter to be selected as the discriminating cue. Furthermore, no strategy of learning by selecting the first letter as a cue developed for any of the contrast groups, despite the fact that subjects learned subsequent lists which were similar to prior lists in degree of graphemic contrast. Comparisons in the present study suggested that variables which lead to cue selection may be unrelated to the type of graphemic contrast or to continued contact with similar materials. It is not clear what sort of cue selection strategy subjects will employ if left uninstructed about the nature of the materials to be learned or not provided with an instructional set. Samuels (1970) has suggested that readers use a variety of cues and strategies to recognize words. Further investigation could identify specific cues and strategies and determine their relationship to the type
of materials which must be learned by beginning readers.

Further experimentation about cue selection in begin­ning readers might explore the power of other letters or combinations of letters to be selected as cues. Variables which might affect selection of other letters might be the environment in which they occur, the familiarity that individual students have with certain letters, or meaningfulness of the words to be learned. Verbal learning theory has suggested each as a factor which may affect learning (Postman, 1961; Runquist, 1968, 1970a, 1971).

**Similarity**

There were no significant differences in learning due to type of contrast. Examination of the mean scores reveals that minimal contrast lists were slightly more difficult than systematic or random contrast lists. Hartley (1970) reported no significant difference between minimal or maximal (systematic) contrast groups, but found the performance of the minimal contrast group slightly better than the maximal contrast group. Hartley instructed students that the first letter of minimal contrast words could be used as a discriminating cue. This study did not include instructions about letter cues. Perhaps, instruction about letters accounts for the difference between the findings of the two experiments. If instructions did account for the difference, the two experiments taken together support
Jeffrey and Samuels (1967) contention that letter training facilitates learning. Calling a student's attention to letter differences between words may be an important factor in learning word lists.

Jeffrey and Samuels (1967) also stated that students could be taught groups of highly similar words to force attention to more than a single discriminating feature. Results of this study suggest that without instruction about differences between words, groups of highly similar words are slightly more difficult to learn than groups of less similar words. Instruction about differences might be necessary to help beginning readers learn groups of similar words.

While a limited number of words learned in a paired-associate task cannot be generalized to reading programs as extensive as those used in schools, these results suggest that in isolation, groups of minimal contrast words are only slightly more difficult to learn than other contrast types. Controlling orthographic features of words as well as the method of presentation in the present study seemed to facilitate paired-associate learning no more than a random presentation of words employing semantic controls. Materials themselves may not exert as much influence on learning as type of instruction. For example, giving instructions about phoneme-grapheme relationships may have produced significant differences in learning different types of word lists.
Therefore, other factors may be more important than orthographic features of words. Further experimentation could seek out interactions between orthographic or phonemic features and other variables.

Other experimenters have investigated degrees of similarity of words as related to other factors (Hartley, 1970; Jensen and King, 1970; King and Muehl, 1965; Otto, 1967). King and Muehl noted the distinction between orthographic similarity and phonemic similarity as related to children's learning of words. Hall (1971) also made the distinction between stimulus, response, and association learning. This experiment failed to separate the effects of orthographic stimuli from phonemic responses, or the effects of stimulus learning from response learning. Further experimentation might explore the effects of orthographic features, phonemic features, stimulus features, and response features independently. For instance, minimal contrast items might be learned as responses more quickly than random contrast items. However, subjects might have more difficulty associating the minimal contrast responses with their written stimulus terms.

Transfer

No significant differences were found in learning transfer lists for any of the contrast groups. A general transfer effect was hypothesized for all groups. Mean
scores were presented in Table 12 in Chapter IV. An examination of means of successive systematic and random lists showed a small increment. The performance of the minimal contrast group was more erratic. Differences for the minimal contrast group might be explained by the fact that subjects did not acquire the lists to as high a degree of learning as other contrast lists. The general transfer effect of learning by cue selection failed to materialize for the minimal contrast group and learning each list may have constituted a difficult, but separate task for the pupils.

Mediated positive transfer was hypothesized for the systematic contrast group. The question at hand was whether or not orthographic and phonemic similarity materials could be involved in mediated transfer for naive subjects. No significant amounts of transfer appeared. With kindergarten subjects, results do not support the suggestion of Runquist (1969) that mediated mechanisms in transfer may also apply to formal similarity. Conclusions about the relationship between mediated transfer and formal similarity are limited by two variables specific to this experiment. These were the time between learning the lists and the nature of the subjects.

The issue of whether or not mediated transfer could occur without an awareness of similarity relations between lists was important to this study. Some subjects did state that words in successive systematic lists were similar to
words in previous lists. However, this stated awareness was not measured and conclusions about its contribution to transfer cannot be made. Rather, acquisition data indicated that systematic lists were as easily acquired as random lists. The experimenter concluded that because subjects were new to the word identification process, each list was probably viewed as a separate learning task since subjects seemed unable to capitalize on the similarity relationships they observed. This is evidenced by the lack of facilitation in the acquisition of subsequent lists. Results lend limited support to the contention that a few well known words may facilitate learning subsequent words in beginning reading. These well known words may provide a basis for drawing attention to similarity relationships among written words.

Various instructional manuals caution teachers that previously learned words may serve as sources of interference for learning similar words (Bank Street School of Education, 1965, p. 222; Harris and Clark, 1965, p. 166). Results of this study suggested that for a small sample of beginning readers, similar words did not serve as a source of facilitation or interference. Rather, similar words in successive lists were learned in the same manner as the random contrast condition of presentation. Further research could record the responses subjects make in learning systematic contrast lists. A record of errors for successive lists would provide
further evidence about the role of similar items as sources of proactive inhibition.

In addition, further research could examine the specific transfer effect of various degrees of similarity. Other variables which may affect specific transfer are instruction about similarities, degree of learning, time between learning similar words, and degree of reading skill of the students. Further research could seek out conditions in which mediated transfer of formal similarity materials could occur.

Retention

No significant differences in retention were found between contrast groups or within contrast groups. A significant effect was found for successive lists when all contrast groups were considered together. However, in a repeated measures analysis of variance the $F$ is positively biased. Tukey's HSD procedure, a conservative post hoc test, failed to establish significance between means for successive lists.

Examination of the means between and within groups indicated some, but no significant, degree of proactive interference for the second and third list of each group. The means of the minimal contrast group were lowest, but this effect was probably due to the lower degree of learning of the minimal contrast lists than to the effects of
specific similarity relations within lists. Although there were no significant differences, the general trend of the means tends to support Underwood's theory of proactive interference (Underwood, 1957).

Words in the systematic group were forgotten to the same degree as words in the random contrast group. Similarity relations in the systematic group neither contributed to positive transfer in learning, nor facilitated retention. Results neither support nor contradict studies of proactive interference which used associative similarity materials (Slamecka and Ceraso, 1960; Postman, 1961). Results agree with those of Hartley (1970) who found no significant differences in retention between minimal and maximal (systematic) contrast lists. An examination of the types of errors that subjects made to the retention tests might have revealed more information about factors which influence retention. Neither the Hartley study nor the present one examined errors on the retention tests.

Further research about retention could examine the types of errors that subjects make after learning different types of word lists. Although no record was kept of responses subjects made to the retention tests, the types of errors that were made appeared to differ for the contrast groups. The subjects in the minimal contrast group appeared to remember the correct responses but could not associate them with the correct stimulus words. This observation
lends support to the theory that differentiation lapses over time and allows a generalization of responses (Gibson, 1940). In contrast, the errors of the systematic and random contrast groups on subsequent lists were characterized by intrusions from lists learned previously. This observation seems to support the proactive interference theory of forgetting (Underwood, 1957). Further research could record the errors subjects make to determine if the types of word lists are subject to different causes of forgetting.

In conclusion, retention is a product of many variables. Results of this study indicated that there is a general decline in retention as more words are learned. The effects of similarity relations within a list were inconclusive. Subjects in the minimal contrast group probably forgot more words because they didn't learn them as well as subjects in the other contrast groups. Systematic presentation of words did no more to aid retention than a random presentation of words. Future research could explore the influence of other degrees of similarity or other degrees of learning on retention of words. While not significant, differences suggested that proactive interference may have operated on naive readers. Future research could explore the conditions in which proactive interference exerts a more powerful influence on naive as well as skilled readers. Finally, retention has been related to a variety of other factors. Further research could seek out interactions
between similarity relationships and other factors such as time between learning and presentation of the word for recall, number of words learned in a single lesson, type of cue which accompanies the word, meaning of the words, and psychological state of the learner. Further research may lead to the discovery of other methods to foster retention in beginning reading than the traditional one of controlling the number of words presented in a lesson, and constant repetition of the new words.
Directions for Experimenters

Day 1

Hello, my name is _____________. What is your name? I am going to teach you to read some words today. The words are printed on these little cards. First, I will show them to you one at a time and tell you what the words are. Then, I will show them to you again and you will tell me what the words are. We will continue until you learn all the words.

Now, I want to show you how we will work together. I will show you a card with a picture on it and I will tell you its name. Then I will show you the pictures again and you tell me its name.

(E does the warm-up task as many time as necessary for S to give one successful trial.)

Good, now you are ready to learn to read the words.

(E then proceeds with study-test trials. E replies to correct responses with: Yes, you are right. E replies to incorrect responses with: No, the word is ___________. Say _________. Each presentation of a word takes no more than 30 seconds. If S does not respond in 30 seconds, E counts the presentation as an error and says: This word is ___________. Say _________.}
Study-test trials continue until the subject
gets fifteen trials).

That was very good. Tomorrow I will ask you to re­
member these words and to learn some more. (Directions and
Stimulus Selection Test for One-Half of Subjects in Each
Treatment Group) Thank you very much. You can return to
your room now.

**Subsequent Days**

Hello, ! I am glad you could come back
today. I am going to teach you to read some more words
today, but first I want to know if you can remember the
words you learned yesterday. I will show them to you on the
cards and you tell me what the word is. Here are the cards.

(E shows S cards one at a time, records
responses, but makes no statement about cor­
rect responses or errors. After thirty seconds,
non-responses are counted as errors, and E pro­
ceeds to the next card. Continue this procedure
until all words have been tested.)

Good. Now you are ready to learn some new words. I
want to remind you how you will learn them. The new words
are printed on these cards. I will show them to you and tell
you what the word is. Then I will show them to you again and
you can tell me what the word is. If you don't know the word,
I will tell you what it is. Let's begin.
(Study test trials continue until the subject receives fifteen trials.)

Good. You did fine. I hope you can come back tomorrow. I will ask you to remember these words and to learn a few more. (Omit "... a few more" after List 4. Give directions for stimulus selection test after List 4 is learned.) Thank you very much. You can return to your room now.

Directions for Stimulus Selection Test

On List 1, half of the subjects in each contrast group received the stimulus selection test. On List 4, all of the subjects in all contrast groups received the stimulus selection test. The test was administered after a two minute rest interval following completion of the learning trials. The experimenter gave the following directions: Before you go back to your room I would like to do one more thing. I will show you some cards with just a single letter on it. Let's see if you can tell me what word the letter stands for. The experimenter presents the cards one at a time. No reply is given to the responses of the student.
BIBLIOGRAPHY

Alin, L. H. Proactive inhibition as a function of the time interval between the learning of the two tasks and the number of prior lists. *Journal of Verbal Learning and Verbal Behavior, 1968, 7, 1024-1029.*


Bell, H. M. The comparative legibility of typewriting, manuscript and cursive writing. *Journal of Psychology, 1939, 8, 311-320.*

Bennett, A. An analysis of errors in word recognition made by retarded readers. *Journal of Educational Psychology, 1942, 33, 25-38.*


Cattell, J. M. The time it takes to see and name objects. Mind, 1886, 11, 63-65.


Dale, E. & Schub, E. A list of 1400 words known by 75% or more of first grade children in the enrichment program of the Columbus (Ohio) public schools. Unpublished research paper, Ohio State University, 1971.


Davidson, H. P. An experimental study of bright, average, and dull children at the four year mental level. Genetic Psychology Monographs, 1931, 9, 119-225.


Gates, A. I. & Boeker, E. A study of initial stages in reading by pre-school children. Teachers College Record, 1923, 24, 469-488.


Hartley, R. N. Effects of word list types and cues on the learning of word lists. Reading Research Quarterly, 1970, 6, 97-121.


Houston, J. P. Stimulus selection as influenced by degrees of learning, attention, prior associations, and experience with the stimulus components. Journal of Experimental Psychology, 1967, 73, 509-516.


Muehl, S. The effects of visual discrimination pre-training with word and letter stimuli on learning to read a word list in kindergarten children. *Journal of Educational Psychology*, 1961, 52, 215-221.


Runquist, W. N. Functions relating intra-list stimulus similarity to acquisition performance with a variety of materials. Journal of Verbal Learning and Verbal Behavior, 1968a, 7, 549-553.


