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THE DIFFERENTIAL EFFECTS OF STILL ILLUSTRATIONS, MOTION ILLUSTRATIONS, AND MODELING PLUS VERBAL DIRECTIONS ON MANUSCRIPT LETTER FORMATION BEHAVIOR OF KINDERGARTEN STUDENTS

The Ohio State University

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THE DIFFERENTIAL EFFECTS OF
STILL ILLUSTRATIONS, MOTION ILLUSTRATIONS, AND MODELING PLUS
VERBAL DIRECTIONS ON MANUSCRIPT LETTER FORMATION BEHAVIOR
OF KINDERGARTEN STUDENTS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By
Louis John LaNunziata, Jr., A.A., B.S., M.Ed.

* * * * *

The Ohio State University
1982

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There are several people whom I wish to thank and recognize for the help they have given me throughout the completion of this dissertation and my doctoral program. To begin with, I'd like to thank my committee members for their support, guidance and encouragement. Special thanks to Dr. John O. Cooper, my advisor and friend, for the endless support and reinforcement he provided me. His ability to direct, advise and cultivate a student is remarkable. He provided the stimulus to endure the rough times and rejoiced with me during the good times. Above all, he has served as a superb model for me to follow in future professional roles. I can only hope to approximate his excellence as a professor and advisor. Special thanks to Dr. David S. Hill, unofficial advisor and very official friend. It would be impossible for me to list the numerous occasions he provided academic, social, and emotional support throughout my program. I will remember the many unselfish hours spent giving me advice and helping me with difficult decisions. Thanks to Dr. Jennifer Porter for the assistance given me in the area of handwriting and the advice and support during completion of the dissertation. Thanks also to Dr. Thomas M. Stephens, Department Chairman, for the guidance and feedback given to me throughout my program. He went beyond academics and provided me with the administrative and social skills necessary
for future professional development. Special thank to Dr. Kenneth P. Hunt, M.ED. advisor and friend, for suggesting a doctoral program and providing me with the skills necessary to build upon. And thanks to Autumn Harless, an outstanding typist, who turned many rough drafts and this dissertation into fine final products.

Of course, special thanks to my wife, Catherine, for sailing with me through calm and stormy waters, and for just being there when needed.
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Chapter I
INTRODUCTION

Background

A national survey of six hundred school systems in 1962 revealed that 98 percent of the teachers reported that they teach handwriting (Herrick & Okada, 1963). Handwriting is an important skill for school-age children to obtain. It is a means of individualized expression whose relationship to the development of the other language arts has been demonstrated to some extent by research (Peck, Askov & Fairchild, 1980). Handwriting is a set of symbols, used for communication purposes, which must be easily read and interpreted by the person or persons for whom it was written. It must, in fact, be legible.

Letter formation is regarded as one of the most important elements of legibility (Burns & Broman, 1975; Hirsch & Niedermeyer, 1973; Wright & Allen, 1975). Initially, manuscript letter formations are taught to children, usually introduced to them about the age of five or six. Frequently, the selection of most instructional procedures in teaching letter formation has tended to be based upon tradition rather than research (Askov & Greff, 1975; Askov, Otto, & Askov, 1970; Gray, 1969). In their national review of instructional practices,
Herrick and Okada (1963) reported that copying was the teachers' preferred method and noted that teaching practices did not result from research findings so much as from traditionally used procedures.

Recently, a few studies have focused on children's handwriting performance when taught by certain methods of instruction. Birch and Lefford (1967) found that children, ages five to eleven, scored significantly higher on activities involving tracing than on activities involving freehand drawing from a model or any other type of visual support. In their review of handwriting research, Askov, Otto, and Askov (1970) suggested that tracing might be more efficient for young children than copying from a model.

Hirsch (1973) and Hirsch and Niedermeyer (1973), on the other hand, examined the effects of copying and faded tracing on letter formations of kindergarten children and found that copying was more effective than faded tracing in promoting correct letter formation behavior. Askov and Greff (1975) replicated the Hirsch and Niedermeyer experiment using shorthand characters and also found copying from a model superior to tracing as a method of instruction for character formation. This prompted them to suggest future research examine techniques to aid children in visualizing and internalizing the model from which they are to copy.

A study by Sovik (1976) compared the following three techniques of instruction: 1) copying still letterlike figures (still illustration); 2) attending to an experimenter's hand while the figure
was drawn and then copying the letterlike figure (modeling); and
3) a combination of modeling and verbal instructions. Increased
accuracy scores were demonstrated by the twenty-four eight-year-old
subjects for all treatments.

A study comparing the effectiveness of still illustrations versus
motion illustrations on manuscript letter formation of 120 first
grade students was done by Wright and Wright (1980). Flipbooks for
lower-case manuscript letters were designed for use as the motion
illustration technique. Results showed that the motion illustration
group performance on letter formation and legibility was significantly
better than that of the still illustration group.

To date, studies in the area of handwriting have not compared
the differential effects of still illustrations, motion illustrations,
and modeling plus verbal directions on handwriting letter formation
in any one experiment.

Statement of the Problem

The review of the literature on handwriting legibility indicates
that improvements in letter formations have the greatest effect on
improvement of legibility. Most students learn to form letters by
copying letters from a model or after teacher modeling of letter for­
mation on a board. The most frequently used techniques to promote
letter copying behavior are presenting students with a still illustra­
tion of letters to copy from or by modeling formation of letters on
a board while providing simple verbal directions concerning the
formation of letters. Recently, motion illustrations, which depict
the direction of letter stroke formation through continual movement, has been introduced as another technique to promote letter copying behavior.

The first priority of this study was to compare the differential effects of using still illustrations, motion illustrations, and modeling plus verbal directions as antecedent techniques to promote accurate copying behavior of kindergarten students' lower-case manuscript letter formations. A second part of the study investigated whether an increase in lower-case manuscript letter formation accuracy for a set of letters written in isolation during the use of one of the antecedent techniques would transfer to a similar level of accuracy for that set of letters when written in context of words in a sentence.

If letter formation accuracy of students could be increased by using still illustrations, motion illustrations, or modeling plus verbal directions, this study would have important implications for the teaching of handwriting in kindergarten since teachers could employ these techniques as an effective means of individualizing handwriting instruction. Also, if one of the antecedent techniques demonstrated the greatest increase in performance for the group of kindergarten students, teachers could concentrate on using that technique during handwriting instruction. Finally, if the increase in letter accuracy transferred from letters written in isolation to letters written in context of words, teachers' instructional time could be used much more efficiently.
The study attempted to address the following questions:

1. Which, if any, of the antecedent techniques used to promote letter copying behavior (still illustration, motion illustration, and modeling plus verbal directions) will result in an increase in the percentage of correct lower-case manuscript letter strokes of kindergarten students?

2. Which antecedent technique will result in the greatest increase in the percentage of correct letter strokes of kindergarten students?

3. Will a functional relationship (experimental control) be demonstrated between any antecedent technique and student performance?

4. If an increase in accuracy for a set of letters written in isolation occurs under any antecedent technique, will this change transfer to that set of letters when written in context of words in a sentence?

**Operational Definition of Terms**

For the purposes of this study, the following operational definitions of technical terms were used:

1. **Baseline Probe Sheet**: A sheet of the 26 lower-case manuscript letters from the Zaner-Bloser Creative Growth Manuscript Alphabet (1974) which
was given to the students during Baseline Condition without any form of directions other than to copy the letters. A copy of the baseline probe sheet is included in Appendix A.

2. **Closed Curve**: The union of a set of segments and/or curves so that the end points of one is connected to the beginning of the next and so on until the end point of the last is joined to the beginning point of the first (Helwig, 1975).

3. **Copy Paper**: Writing Paper Number 1 published by the Zaner-Bloser Handwriting Company.

4. **Deviation Range**: A certain maximum measured distance that letter strokes can vary from their position in the model letter (Helwig, 1975).

5. **Evaluative Transparent Overlays**: A set of transparent overlays designed by Helwig (1975) with certain closed curves imprinted on it, through which an individual can determine if letter strokes meet criterion.

6. **Handwriting**: A style or way of forming letters and words by hand with pencil, pen, etc., when writing (Zaner-Bloser, 1974).

7. **In-Context Handwriting Model Sheet**: A model sheet used for letters written in context which contained all 26 lower-case manuscript letters.
used in interventions. Letters were written in context of words in the sentence, "The quick fox jumps over the lazy brown dog."

8. **Modeling Plus Verbal Directions**: An instructional technique in which an experimenter wrote and verbally described the formation of a letter on a blackboard before students copied the letter on their paper.

9. **Model Letters**: Any or all of the set of 26 lower-case letters from the Zaner-Bloser Creative Growth Manuscript Alphabet (1974).

10. **Motion Illustration**: An instructional technique in which an animated overlay displays a letter on a screen while demonstrating, through constant movement, the direction of each stroke used in the letter formation. Students observed the letter displayed, then copied it. The animated overlays were designed for use with an overhead projector using a specially designed adaptor.

11. **Motion Overlays**: A set of overlays, developed by The Educational Dynamics Corporation (1977) which, when used with an adapted overhead projector, provides moving illustrations of manuscript letter formations.
12. **Parameter:** A constant mathematical measured distance between two segments, arcs, or circles (Helwig, 1975).

13. **Accuracy:** The mean percentage of correct strokes generally rounded to the closest tenth (70%, 80%, 90%, 100%) when measured with one of the evaluative overlays.

14. **Recording Form:** A set of three sheets containing model letter strokes (one for each intervention) developed for recording correct and incorrect strokes made by the subject. (A copy of each is contained in Appendix B.)

15. **Still Illustration:** An instructional technique in which students were given a sheet of still model letters containing arrows and numbers which indicated the direction of letter stroke formation and told to copy the letters on their paper.

16. **Stroke:** As defined by the Zaner-Bloser Creative Growth Alphabet (1974), "a continuous set of points as demonstrated by the mark formed when a writing implement touches the paper, is moved across the paper, and withdrawn."

17. **Trained Letters:** The set of 26 lower-case manuscript letters written in isolation during
the three interventions of the experiment, but not written in context of words in a sentence.

18. **Urban Preschool**: A preschool situated in a residential area within five miles of the city's center near The Ohio State University.

19. **Writing Implement**: Zaner-Bloser standard pencil.
Chapter II
REVIEW OF THE LITERATURE

An overview of articles and research on handwriting and the teaching of handwriting is presented in this review. Two sections are included. Section one reviews the evolvement of handwriting instruction, and the development of handwriting skills in children. Section two is a review of the teaching of handwriting including the nature of handwriting programs, the handwriting curriculum, variables effecting the teaching of handwriting, and a comparison of instructional techniques used in handwriting instruction.

Evolvement of Handwriting Instruction

As the skill of handwriting became more and more important to society as an instrument of effective communication, the teaching of handwriting began to grow. Large-scale teaching of handwriting in schools probably began with the introduction of compulsory education in Britain in 1870 during which the basis of elementary education was instruction in the three Rs—reading, writing, and arithmetic. Handwriting curricula largely emphasized the mechanical skills of handwriting as it does today, without which, children are frustrated in their attempts to communicate (Smith, 1977).

Handwriting "is one of the basic fundamental subjects in the elementary school curriculum" (King, 1961). Together with reading
and arithmetic, handwriting is one of the elementary and essential mediums of all teaching. It is taught in the early stages of education in almost every country. The formal teaching of handwriting usually begins in preschool, kindergarten, or grade one. The number of years devoted to the formal teaching of handwriting varies from country to country ranging from four years to eleven years (International Bureau of Education, 1948).

In the United States "from near the beginning of this century up until the early forties, handwriting in many schools was better taught than had been generally the case before or has been the case since" (Enstrom, 1970, pp. 133-136). Enstrom suggests this occurred because schools had employed "penmanship supervisors," belonging to the National Association of Penmanship Teachers and Supervisors, who were trained by colleges and handwriting supply companies to teach handwriting. However, during the Great Depression of 1929, schools began to cut curriculum costs including most of these handwriting instructors and the quality of handwriting declined.

Another factor adding to the deterioration of efficient handwriting instruction occurred during the so called "Progressive Education Movement" when many teachers began to give incidental attention to the area of handwriting instruction (King, 1961). In fact, in 1961, King surveyed school systems in 680 cities with a population of 2000 or greater and found that 50 percent of the teachers reported no scheduled classes for handwriting instruction and that 30 percent of the schools purchased no handwriting books.
or materials (King, 1961). Enstrom (1970) concluded that this neglect of handwriting instruction was a major reason for the great amount of illegible handwriting displayed in schools as of 1970.

This does not imply that handwriting was not being taught in the schools, simply that it was given incidental attention by most teachers. Indeed, Herrick and Okada (1963) reported the results of a national survey of six hundred school systems in 1962 which revealed that 98 percent of the teachers responding reported teaching handwriting to one degree or another. However, many researchers agree that the quality of handwriting instruction and time devoted to it by teachers are less than adequate, resulting in a general decline in the quality of handwriting performance (Freeman, 1954).

This lack of importance toward handwriting instruction has severely penalized school children in their learning efforts. Enstrom (1970) notes this as he states:

When handwriting is a slow, plodding endeavor that ends in a product that can barely be read, learnings always suffer. Precious school hours are needlessly wasted in the writing process; teacher correction attempts are reduced to a long drawn-out frustrating ordeal. Can we call this quality education?" (p. 133).

Despite this lack of quality handwriting instruction in the elementary grades, teachers often demand quality handwriting from their students in the form of final products. One need only go into the
schools and listen to teacher complaints concerning their students illegible handwriting to realize this. Yet, placing such demands on students who have been poorly trained in handwriting not only is unfair, but creates frustration and anxiety. Teachers need not place the blame of poor handwriting skills on students, for the students are willing and ready to learn if only they were taught efficiently.

The Development of Handwriting Skills in Children

Children usually become interested in writing at an early age. By the age of two, they are usually fascinated with scribbling. At approximately age three, many children realize that people make marks on paper purposefully. Somewhere between the ages of four and five, most children attempt to formulate both letters and numbers" (Graham & Miller, 1980).

When formal instruction is introduced, usually around the age of five or six, the students' quality of penmanship is poor, gradually improving with practice (Anderson, 1969; Covert, 1953; Groff, 1964). Speed in writing also increases with practice from about 36 letters per minute in grade two to 50-72 letters per minute in grade six (Freeman, 1915a; Groff, 1961). The skills of quality and speed usually vary together in children (Wills, 1938).

It is accurate to state that although for the most part children enjoy learning to write, some students develop an aversion to penmanship (Quint, 1958). Several researchers have noted, for example, that boys are more likely than girls to dislike handwriting and that girls
are often better writers than boys (Anderson, 1969; Gates & LaSalle, 1924; Groff, 1964; Horton, 1969; Lewis, 1964; Love, 1965; Trankell, 1956). Several possible reasons have been offered for this occurrence, perhaps the most plausible being that of the practice of differential reinforcement of boys and girls.

As students write more and acquire speed, they often become careless and take shortcuts in letter formations (Graham & Miller, 1980). This results in the development of a personal style of handwriting in adulthood (Harris & Rarick, 1959; Quint, 1958; Seifert, 1959) which is often less legible than that of upper elementary and junior high school students (Newland, 1932). Students often exhibit different standards of penmanship depending upon the exercise (Graham & Miller, 1980). For example, students usually write better on a copying task than on a written composition (Lewis, 1964; Wills, 1938).

Summary

In spite of the importance of handwriting skills as an effective means of communication in society, there has been a general decline in the quality of handwriting since the early part of the twentieth century. Many researchers attribute this to the fact that during the middle and latter part of this century, handwriting instruction in the schools became grossly inadequate.

We cannot fault the student for poor penmanship skills, for most children are eager and able to learn to write. Individual differences effecting students handwriting performance must also be ruled out as a major cause of poor writing skills as Harris (1960)
notes "Legible handwriting has not been found to relate significantly to either eye-hand coordination, race, intelligence, or anatomical age." In addition, researchers have noted that handwriting problems do not seem to be particularly associated with mental retardation (Kvaraceus, 1954; Love, 1965). Milone and Wasylyk further note "The critical ingredient in handwriting success is instruction; it can overcome physical and mental disability, social disadvantages, and other factors that often impede educational progress. The best handwriting is found among students in classes in which handwriting is taught. Therefore, if you want your exceptional children to learn good penmanship, you must teach it directly" (1981, p. 58).

The more viable explanation seems to be "that most handwriting difficulties are the result of inadequate instruction" (Graham & Miller, 1980, p. 1).

There is no answer for combating any educational weakness other than the installation of strong programs. Instructional weakness must be replaced with instructional strength" (Enstrom, 1970, p. 134).

Teachers can no longer afford to regard handwriting instruction as an incidental matter, nor should students continue to lose valuable instructional time trying to complete assignments in a readable manner. To expect students poorly trained in handwriting to achieve satisfactorily in other subject areas is analogous to "the woodcutter who is so busy with his chopping that he hasn't time to sharpen his axe" (Enstrom, 1965, p. 185). Educators must, once again, begin to regard
the teaching of handwriting as highly important and concentrate on improving methods of instruction.

The Teaching of Handwriting

The Nature of Handwriting Programs

Instructional programming. In spite of the practical aspects of handwriting and its frequency of use, well planned educational programs for the diagnosis and remediation of handwriting difficulties are rare (Herrick & Okada, 1963). There are, however, several programs for handwriting instruction in our schools which share some common characteristics. In their national survey of six hundred school systems in 1962, Herrick and Okada (1963) found that the general nature of instructional programming in handwriting consisted of the following:

1. More than 95 percent of all teachers reporting (98 percent in national survey, 95 percent in Wisconsin) report that they do teach handwriting.

2. The prevailing pattern in teaching writing skills in schools is the teaching of both manuscript and cursive writing (79 percent national and 97 percent Wisconsin). Fourteen percent of the school systems reporting taught cursive writing only; 7 percent manuscript only.

3. Changes in instructional pattern have been from all-cursive writing to manuscript in the early grades with a transition to cursive writing in the upper grades.
4. Most schools start formal instruction in handwriting in the first grade.

5. Over 70 percent of the schools make the transition from manuscript to cursive writing between the second half of the second grade and the first half of the third grade. Practically all of the schools make it by the first half of the fourth grade.

6. Most schools teach handwriting five times a week in grades 1 to 4 and three times a week in grades 5 to 8.

7. A 15- to 20-minute class period is the favored time unit for handwriting instruction at all grade levels.

8. Schools favor a separate handwriting class period plus teaching handwriting in some meaningful context in all subject matter areas. Fifteen percent of the responses indicated handwriting and spelling were taught together regularly.

9. Only one school in five attempts to individualize the instruction in handwriting. One the basis of the questionnaire returns, children are given little help in recognizing their own errors and in developing their own styles of handwriting" (Herrick & Okada, 1963, pp. 19-20).
Factors emphasized in instructional programs. Another section of Herrick and Okada's survey explained factors emphasized by teachers in handwriting instruction. Teachers rated their emphasis through the first six grades on six factors of writing which were: correctness of letter formation, size of letters, uniformity of letters, spacing of letters and words, alignment of words and sentences and neatness of writing. Table 1 illustrates the order of importance and level of emphasis placed on these factors by grade level.

A review of the literature since 1963 shows little change in the general nature of handwriting instruction since the Herrick and Okada study. Although individualized instruction in handwriting occurs more frequently, this is usually restricted to programs for handicapped children (Hovett, 1966; Jackson, 1974).

The handwriting curriculum. Essentially, handwriting is a means for expressing, communicating and recording ideas. It results in a tangible, permanent product. Handwriting is considered as a means to an end, not an end unto itself and should, therefore, be produced with maximum efficiency and minimum effort (Graham & Miller, 1980).

There is no accepted standard alphabet form used in instruction (Herrick & Otto, 1961). Considerable variations are found in the speed, stability and legibility of different forms of the same alphabet letter (Boraas, 1936). Thus, when selecting a teaching alphabet, emphasis should be placed on simplicity, readability and speed of production (Graham & Miller, 1980).
### Table 1

Order of Importance and Level of Emphasis of Factors of Writing*

National Survey

<table>
<thead>
<tr>
<th>Order of Importance (Assigned by Responses)</th>
<th>High Point of Emphasis (Assigned by Responses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Correctness of letter formation</td>
<td>1. First through third grades</td>
</tr>
<tr>
<td>2. Neatness of writing</td>
<td>2. Second grade</td>
</tr>
<tr>
<td>4. Spacing of letters</td>
<td>4. Second grade</td>
</tr>
<tr>
<td>5. Size of letters</td>
<td>5. Second and third grades</td>
</tr>
<tr>
<td>6. Alignment of words and sentences</td>
<td>6. Sixth grade</td>
</tr>
<tr>
<td>7. Speed of writing</td>
<td>7. Fifth and sixth grades</td>
</tr>
</tbody>
</table>

Manuscript or cursive. The handwriting curriculum of most schools consists of the teaching of manuscript and cursive styles of writing. There is considerable controversy concerning the merits of manuscript versus cursive writing. A few researchers believe it is more difficult for a student to master two sets of handwriting symbols than to perfect one set, whether manuscript or cursive. Templin and King (1964) state that the "changeover in the majority of schools appears to be producing handwriting cripples." Other researchers, however, believe manuscript writing must be taught before introducing cursive writing in order for the student to become a proficient writer (Anderson, 1972; Furner, 1969).

This argument grows in intensity within the field of special education where many authorities suggest that cursive writing should be taught solely, beginning in the primary grades, to children with learning disabilities (Joseph & Mullins, 1970; McGinnis, 1963; Orton, 1937; Strauss & Lehtinen, 1948). On the other hand, Johnson and Myklebust (1967), believe the dyslexic child learns only one form of writing as to avoid confusion and advocate manuscript printing because of its practicality and simplicity. Still others advocate that manuscript print be maintained throughout the instructional program and then, when appropriate, cursive script should be taught as a separate but related skill (Graham & Miller, 1980).

Despite the controversy involving instruction in either manuscript or cursive style, formal handwriting instruction in most schools consists of the instruction of both styles. After the student is
skilled in manuscript, instruction is provided for cursive handwriting. The question of when to introduce cursive writing to students is still very unclear. A common practice in schools is to make the transition to formal cursive instruction when a student reaches a specific grade (e.g., second or third grade) or age level (e.g., seven or eight). Although experimental studies concerning possible variables which could be used as criteria for transition are scarce, one study by Leung, Treblas, Porter and Cooper (1982) found that performance in manuscript handwriting can be used as a behavioral assessment procedure for transition to cursive handwriting.

Handwriting legibility. A major skill emphasized in the handwriting curriculum is that of legibility. "Conventionally, the quality of handwriting had been rated on the basis of legibility" (Graham & Miller, 1980). Legibility, as defined by Lehman (1973) is:
the formal adequacy of the letters to communicate, and results from high formal correspondence between the handwriting and a model that the reader is prepared to recognize. Legibility is a natural consequence of handwriting produced with distinctive, simple letter models in proportioned form" (p. 326).

Legibility, or the ease with which writing can be read, is a crucial element to successful handwriting. Several researchers have indicated that readability of print is affected by several factors including letter form, uniformity of slant, size of letters, compactness of
space within and between words, alignment, and line of quality (Anderson, 1969; Craig, 1965; Jackson, 1970).

Herrick and Okada (1963) analyzed more than 3500 questionnaires returned to them by randomly selected elementary school teachers throughout the United States and found that most teachers viewed the correctness of letter formation as the most important factor of legibility. In this regard, Quant (1946) states that "since letter formation is the most important factor in determining the legibility of handwriting, this aspect of writing should receive the greatest emphasis in teaching children to write" (p. 315). Thus, a major part of the handwriting curriculum involves the development of good letter formation . . . a primary requisite to the development of legible handwriting.

Measurement of legibility. Concerning the evaluation of handwriting legibility, most of the evaluative devices used by teachers are subjective in nature (Rondinella, 1963). The most widely used instruments to measure legibility are handwriting rating scales which are designed, for the most part, to compare a student's sample with a range of specimens on a scale from "poor" to "excellent."

Two of the more widely used scales were developed by West (1957) and Freeman (1959). Each grade scale contains a number of quality levels for handwriting which measure the characteristics of quality or speed (West, 1957) or the characteristics of legibility, form ease, and fluency (Freeman, 1959). West's and Freeman's scales measure cursive handwriting samples.
Generally, most handwriting scales are considered unreliable (Anderson, 1965; Feldt, 1962) and subjective in nature. After an examination of all major scales through 1960, Harris, Herrick, and Rarick (1961) concluded:

a. There is no real zero or perfect sample in a scale derived from these judgments.

b. The number of quality levels possible in a scale is determined by the number of differences in quality reliably maintained by an adequate number of judges.

c. Scales produced on this basis are ordinal and not cardinal in character. (Level 1 is better or worse than level 3; it is not, however, three times worse or better.)

d. Scales produced on this basis are meaningful only within the population of samples which are used to produce the scale levels. A sixth grade scale produced on one sixth grade population of writing samples need not be similar either in range or level of quality with another sixth grade scale even though both distinguish six levels of handwriting quality" (p. 24).

In their review of handwriting research in the 1960's, Askov, Otto, and Askov (1971) conclude "when such scales are brought into the classroom, ... ratings by individuals tend to have low reliability" (p. 45).
Recently, easily implemented, objective, and reliable procedures for measuring manuscript letter formations have been developed. Helwig, Johns, Norman, and Cooper (1976) designed transparent overlays on which are printed tolerance models of letters, used by teachers to reliably measure deviations of student samples from model letters. The use of these overlays by students to reliably measure their own lowercase manuscript letter formations has been demonstrated in a study by Johns, Trap, and Cooper (1977). Although not presently widely used, these findings suggest the use of transparent overlays as an objective handwriting measurement method can be used accurately and reliably by teachers, aides, or students. Peck, Askov, and Fairchild (1980) in their review of handwriting research in the 1970's, referred to the use of this measurement technique as a "promising evaluation method" (p. 297).

Commercially available materials. There are several commercially available handwriting materials, texts, or programs used as part of the handwriting curriculum. A survey of 680 school districts in four midwestern states in 1961 revealed that fourteen commercial handwriting systems were being used at that time.

Recently, a new handwriting system has been developed by Scott Foresman entitled D'Nealian Handwriting (Scott Foresman, 1978), which a growing number of teachers are employing. The major difference in the D'Nealian and traditional methods of teaching handwriting occurs within the manuscript alphabet in which the D'Nealian lower-case manuscript letters are formed in one continuous stroke and are slanted.
Sales promotion material for the D'Nealian Alphabet claim that this new alphabet will facilitate transition between manuscript and cursive writing. To date, experimental verification of this effect has not occurred.

**Variables effecting the teaching of handwriting.** Methodological procedures often characterize possible variables effecting children's writing which teachers feel are important. Some teachers, for example, stress instructional procedures which emphasize the perceptual-motor nature of learning in handwriting. Furner (1969) states "the method of instruction utilized in handwriting must, if it is to be successful, stress perceptual development and insure the utilization of the perceptual model as a basis for motor practice" (p. 1021). This approach, also referred to as a process-based instruction (Gerard & Junkala, 1980), emphasizes the training of visual-motor process deficits as the road to remediation of poor handwriting skills. Hebb (1949) suggests that perception is, in part, a learned behavior involving both motor and perceptual actions (Hayes, 1982). In this regard, Furner (1969) believes the coordination of perceptual and motor systems can be influenced by use of the auditory process, among others, to reinforce visualization of letters.

Instructional procedures should be designed to provide several exposures to the stimulus, using multisensory techniques (the visual, auditory, and the kinesthetic)" (Furner, 1969, p. 1021).
Furner advocates a perceptual-motor handwriting program for grades one through three which stresses perceptual development through use of a problem solving approach consisting of visual impressions of the act of forming a letter combined with self verbalization of the process involved (Furner, 1969).

The use of process-based instruction, however, has been heavily criticized because of the often questionable reliability of process testing and the absence of demonstrable process-linked academic gains (Gerard & Junkala, 1980). In fact, several researchers have stated that perceptual training emphasized as a technique to improve an academic skill is of questionable value (Hammill, 1972; Stephens, 1977). Still, the view is held by some that "... an emerging theory of handwriting as a perceptual-motor skill, rather than a mere motor task" (Hayes, 1982, p. 170) is underway.

Many other researchers and teachers, however, emphasize a more direct approach to teaching handwriting skills. (Barbe, 1974; Cieslicki, 1980; Hartley, 1980; Lovitt, 1977; Milone & Wasylyk, 1981). This widely used approach has been labeled product or sub-skill teaching which emphasizes the identification of precise responses which are in error and directly teaching the correct response (Stephens, 1977). Directive teaching of handwriting does not involve the training of hypothetical auditory, motor, or visual-perceptual process deficits, but focuses training on the handwriting product: letters and words. Students are taught to recognize their own errors (Harris & Herrick, 1963; Tagotz, Otto, Klausmeier,
Goodman, & Cook, 1969) or are rewarded for their correct responses (Brigham, Finfrock, Breunig, & Gusbell, 1972; Hopkins, Schutle, & Gorton, 1971) (Gerard & Junkala, 1980, p. 54).

This instructional process includes doing an analysis of those handwriting skills which have not yet been mastered and then systematically teaching these skills in a sequential order. Unlike the deficit based approach which blames the child for poor penmanship, illegible handwriting is generally viewed as a product of previously poor instruction.

Other methodological procedures in the teaching of handwriting emphasize relaxation training (Jackson & Hughes, 1978), cognitive-developmental concepts (Frostig & Maslow, 1973), and motor skill training (Cratty, 1969; Haworth, 1971), all based upon possible variables thought be be effecting children's handwriting.

Other more commonly agreed upon variables affecting students' handwriting upon which instruction is based are:

1. The effects of physical development on the handwriting product;
2. The effects of various body part positions on the writing product;
3. The effects of speed and stress on the handwriting product;
4. The effects of handwriting instruments and writing surfaces on the handwriting product.
"Adequate physical development" has been suggested as a signal of readiness for handwriting (Anderson, 1972). Not all children are equally prepared to begin handwriting instruction. Before introducing formal handwriting instruction to students they should have attained sufficient mental maturity and motor control. Some general rules to assessing handwriting readiness are suggested by Graham and Miller (1980) who state:

Generally a student should demonstrate: (a) a mental age of 4.0 to 5.0 (Simon, 1957); (b) an interest and desire to write; (c) adequate muscular coordination; (d) the ability to make visual discriminations; (e) an understanding of the concept of left-to-right progression; (f) a writing hand preference (left or right); and (g) the ability to draw a circle, diagonal line, and horizontal line" (p. 7).

Further readiness activities are described by Page (1964), Peterson (1975), Wright and Allen, (1975), and Towle, (1978).

Concerning various body part positions on handwriting, early studies reveal that children use a combination of finger, hand, and arm movements during writing (Freeman, 1918; Judd, 1911). Since then, a certain grip-movement pattern has come to be accepted as a standard, involving resting the hand on the third and fourth fingers and holding the writing instrument between the thumb and first two fingers (Graham & Miller, 198). Mendoza, Holt, and Jackson (1978) taught children the proper pencil grip by applying colored circles used as
a prompt to the fingers of subjects' dominant hand and to the writing instrument. Children were told to match the colors on their fingers with those on the pencil. An appreciable increase in proper pencil grip was reported for the subjects.

Another variable of concern on body part positions is that of good writing posture. Milone and Wasylyk (1981) suggest that when students distribute their body weight incorrectly by leaning too heavily on a desk or sitting too far back in their seat, they cannot properly control the muscles involved in producing good handwriting. Thus, handwriting becomes illegible. They suggest:

The child should sit upright in the desk with the lower back against the back of the seat. The upper back and shoulders should lean forward. The elbows should be just off the edge of the desk, and the large muscle of the forearm should serve as the pivot for the writing movement (Milone & Wasylyk, 1981, p. 58).

Most handwriting researchers suggest appropriate handwriting posture and movements become established as soon as possible and sustained throughout school (Graham & Miller, 1980).

Although few researchers have examined the effects of speed on legibility, Rice (1976) sought to determine if rate of handwriting could accurately predict the academic achievement and completion of written assignments for 199 sixth grade students. Rate of writing was found to be a significant prediction of language achievement and
assignment completion, prompting Rice to suggest that teachers use rate of handwriting as one means of predicting achievement expectations in these two areas (Peck, Askov, & Fairchild, 1980). In a study examining the effects of accuracy and proficiency (speed) of manuscript writing on the acquisition of cursive letter formation, Leung, Treblas, Porter, and Cooper (1982) concluded "that accuracy, not proficiency in manuscript letter formation, is associated with accuracy in cursive letter formation" (p. 23). However, the Leung, et al. study did not train students in manuscript proficiency. Future research needs to explore the effects of training in manuscript speed on the acquisition of cursive letter formation.

Regarding the effects of handwriting instruments and writing surfaces influencing handwriting instruction, a study by Parker (1972) found that the beginner's pencil (13/32 inches in diameter) had no real advantage over the commonly used pencil (10/32 inches) for students nursery through grade one. Parker, thus suggests the use of beginner's pencils in the lower grades be terminated. Kryesni (1971) explored the use of a ballpoint pen, felt-tip pen, and normal pencil as well as lined and unlined paper for writing on third grade subjects' handwriting. No differences were found with respect to types of paper used regarding writing performance, however, subjects using the ballpoint pens and felt-tip pens scored higher than subjects using pencils on both types of paper.

Concerning the use of paper types, Halpin and Halpin (1976) examined the influence of four paper types on handwriting quality and
placement of letters in a writing space on forty-four kindergarten students. The four types of paper used were one inch wide writing spaces with open ends, one inch wide writing spaces with closed ends, one-half inch wide spaces with open ends, and one-half inch spaces with closed ends. Results of ratings on written samples showed no difference in the quality of handwriting or the placement of letters using the four types of paper. However, it should be noted that the analysis of handwriting samples was done by two judges using five subjective criteria on which they rank ordered the samples.

Leung, Treblas, Hill, and Cooper (1979) extended the Halpin and Halpin study using different grade level subjects and a more objective and direct method of measurement of accuracy of manuscript letter strokes. They compared the effect of large (3.4 cm) and normal (1.6 cm) spaced paper on the handwriting of 143 first grade children. Subjects were randomly divided into one of two groups and were asked to copy lowercase manuscript letters onto one of the two types of paper. The samples were evaluated using transparent overlays developed by Helwig, et al. (1976). Analysis of the data showed a significantly higher degree of accuracy in letter strokes when large-spaced paper was used as opposed to normal spaced. These results are in contrast to the Halpin and Halpin study which found no significant difference in paper size. Two possible explanations for this discrepancy may be the difference in subject grade level and the difference in measurement procedures.
In a follow-up of Leung, et al., Waggoner, LaNunziata, Hill and Cooper (1981) compared the accuracy of handwriting on large-spaced paper (2.25 cm) and smaller spaced paper (1.1 cm) of urban and suburban kindergarten and first grade students. The results of this study indicate that space size of writing paper affects correct manuscript letter strokes of suburban and urban kindergarten students and first grade students. Suburban students made more correct manuscript letter strokes using large-spaced paper than using normal-spaced paper. Space size, however, generated no differences in correct letter strokes for urban students. Suburban students in both grades produced more correct letter strokes using large-spaced paper than urban students, however, there were no differences among suburban and urban students using smaller spaced paper. The results suggest that space size of writing paper results in more correct manuscript letter strokes after a degree of competence in letter formation has been achieved. It would appear, based upon the Leung, et al. and the Waggoner, et al. studies that space size of writing paper may make a difference in handwriting instruction of kindergarten and first grade students. Based upon these results, teachers may wish to train letter formation on large-spaced paper before introducing normal spaced paper.

A Comparison of Instructional Techniques Used in the Teaching of Handwriting

In efforts to teach students to write legibly and with reasonable speed many instructional techniques have evolved. Some of the more
widely practiced instructional techniques involved in the teaching of handwriting include manual guidance, tracing, and copying. Reinforcement and informational feedback have also become recognized as important elements in the teaching of handwriting. Various studies have examined the effects of these instructional techniques on handwriting performance.

Reinforcement and informational feedback. Recent research provides evidence that handwriting skills increase as a function of contingency management or visual and verbal feedback (Fauke, Burnett, Powers, & Sulzer-Azaroff, 1973; Johns, Trap, & Cooper, 1977; Salzberg, Wheeler, Devor, & Hopkins, 1971; Trap, Milner-Davis, Joseph, & Cooper, 1978).

Examples of reinforcing stimuli include the use of intermittent feedback and intermittent contingent access to play on printing of kindergarten children (Salzberg, Wheeler, Devor, & Hopkins, 1971). In this study, Salzberg, et al. provided evidence that the combination of intermittent grading with contingent access to play increased the accuracy of kindergarten children's printing responses. Intermittent grading without the contingent access to play failed to produce an increase in accuracy.

Brigham, et al. (1972) compared three treatments (baseline without tokens, tokens contingent on correct writing responses, and noncontingent tokens) on the academic performance of kindergarten children. Results consistently showed that children were more
accurate when their correct responses produced tokens and that non-contingent tokens reduced accuracy below baseline levels.

Miller and Scheider (1970) investigated teaching the beginning elements of handwriting in a Head Start program by using a token system to reinforce responses to a writing program. The students were given access to a variety of activities normally available in the preschool classroom contingent upon their correct responses. Results showed that responding was maintained as long as access to the reinforcing activities was contingent upon responding. When reinforcement was removed, virtually no responding occurred. It was concluded that the token system is an effective methods for teaching beginning skills of handwriting.

In an experiment examining the effects of feedback and consequences on transitional cursive letter formation of twelve first grade students, Trap, et al. (1978) compared verbal and visual feedback, verbal and visual feedback plus immediate rewriting of trained letters with one or more incorrect strokes, and potential reinforcement on cursive letter stroke formation. The experimenters found that the percentage of correct strokes increased during all conditions and suggested the packaged procedure of feedback, praise and consequences demonstrated improved cursive handwriting.

In a similar study, Johns, Cooper and Porter (1982) examined the effects of (1) training first-grade children to self-record letter strokes, (2) self-record their own samples, (3) self-recording plus public charting of correct letter strokes, and (4) self-recording
plus a low performance group contingency on manuscript handwriting legibility. Students were trained to evaluate their own work using clear plastic overlays developed by Helwig, et al. (1976). Results showed that an increase in correct letter formation occurred when students received feedback through self-recording alone or in a package with public charting or a low performance group contingency.

Several other studies have shown the effectiveness of using reinforcement and informational feedback on increasing academic behaviors of children (Journal of Applied Behavioral Analysis, 1968-1981). Teachers have recognized these as important instructional techniques in the teaching of handwriting skills and usually include some form of reinforcement or informational feedback while teaching handwriting.

Manual guidance. Whether teachers use copying, tracing, or both as an instructional technique in the teaching of handwriting, "there are few teachers who do not use some manual guidance of the child's hand as an instructional procedure in helping children learn to write ..." (Herrick & Okada, 1963). Physical guidance has been used as a prompt successfully by researchers to improve academic and social skills of children and adults (Striefel, Bryan, & Aikins, 1974; Striefel & Wetherby, 1973; Sulzer-Azaroff & Mayer, 1977). Physical guidance as defined by Sulzer-Azaroff and Mayer (1977) is:

A form of response priming in which the appropriate body or parts are "put through" or physically guided through the proper motion. For example, a swimming
coach guiding the movement of a youth's arm to demonstrate the proper stroke is using the physical guidance procedure (p. 520).

In much the same manner, handwriting instruction at the very early stages can use physical guidance by guiding a student's hand to form the correct letter strokes, gradually fading out the prompt of physical guidance until the student can attempt to form the strokes without the prompt. This prompting strategy has been used successfully by handwriting teachers in teaching beginning handwriting to preschool and kindergarten children.

**Tracing and copying.** Tracing is considered by many teachers to be a useful way to reinforce visual images of letter and word forms with their tactile and kinesthetic-sensory impression of the size and position of strokes as well as their sequence of development.

The three procedures most frequently used in tracing are:

1. Tracing over letters in the writing manual with an actual writing instrument such as chalk, crayon, or sharpened pencil.
2. Tracing over letters in the writing manual with fingers, unsharpened pencils, etc.
3. Tracing over letters on large paper or blackboard (least used are tracing with fingers on wood letter forms or on tracing paper) (Herrick & Okada, 1963, p. 23).
An additional procedure used in tracing is that of faded tracing where the tracing prompt is gradually faded out until children are forming letters without prompts. One such procedure used to teach children to draw geometric forms was done by Birch and Lefford (1967) who used the following conditions of various stimulus support:

1. Tracing task. (The child placed his response sheet over the models and traced the lines.)
2. Connecting-dots condition. (Dots were placed at the points where lines intersected and ended on the models; on the Ss' response sheet only the dots were printed in the same positions as on the models.)
3. Dot grid condition. (The models were superimposed on a grid of dots; the child's response page contained only the dot grid.)
4. Line grid conditions. (Similar procedures as with the dot grid except that the grid was composed of straight, intersecting lines.)
5. Freehand drawing from model with dot emphasis. (The models were the same as used in the connecting-dots condition; the S copied the models on a blank page.)
6. Freehand drawing on a blank page. (The S copied the models on a blank page.) (Birch & Lefford, 1967, Whole no. 110).
A series of handbooks designed to teach children to acquire handwriting skills using a shaping procedure were developed by Skinner and Krakower (1968). Initially in the program, letters which can be discriminated easily from other letters are presented to the students in their workbooks. Then the student is guided through a series of steps in forming letters in which more and more precision is required. Through the shaping procedure students gradually learn to form letters correctly. Reinforcement takes place in the form of teacher approval for appropriate performance and the ever increasing similarity of the letters to the model or sample letters presented in the workbook.

Copying seems to be the more preferred method used by teachers for the teaching of handwriting.

The procedures associated with copying according to their frequency of use are:

1. Copying by children from correct forms in books and manuals on their handwriting paper or the blackboard.
2. Copying by children on paper from demonstrations of letter formation by the teacher on the blackboard or in the air. The purpose here, apparently, is to help the child see the proper forming of a letter in action.
3. Copying from a displayed alphabet.
A review of recent literature would seem to support the contention that copying from a model is more effective than tracing in producing legible handwriting. Hirsch (1973) and Hirsch and Niedermeyer (1973) examined the effects of faded tracing and copying on the letter formation of kindergarten children. Subjects in the faded tracing group traced dotted reproductions of letters in which the dots were gradually faded out during twenty-four responses per session. Subjects in the copying group copied model letters twenty-four times per session. There were a total of forty sessions. Results showed that copying was more effective than faded tracing in promoting correct letter formation behavior. However, subject mortality may have posed a threat as the original number of sixty subjects were reduced to fifty-one at the experiments conclusion.

Askov and Greff (1973) replicated the preceding experiment using a different tracing technique and short-hand characters as opposed to letters. Kindergarten and second graders were used and randomly divided into two treatment groups. The copying treatment consisted of copying the short-hand characters. The tracing treatment gave the students a ditto copy of letters to trace and the amount of pressure on the ditto machine was gradually decreased so that worksheets became dimmer. The treatments lasted five weeks. A two way analysis of variance test was used to analyze data. The copying group scored significantly higher (p < .002) in producing correct shorthand characters than did the tracing group. These results support the findings of Hirsch and Niedermeyer.
In a study conducted by Williams (1975), the effectiveness of copying and visual discrimination on the ability of forty Black day-care center children of low socioeconomic background to reproduce letterlike forms was examined. Four training methods were used which were: copying, discrimination (tracing), combination (both copying and tracing), or no training. The discrimination group practiced matching-to-standard items consisting of letterlike forms. The copying group reproduced letterlike forms on paper from model cards. An analysis of covariance test revealed that discrimination training was significantly superior to the other three conditions. This is in contrast to the results reported by Hirsch and Niedermeyer (1973). However, the findings of this experiment must be limited to children similar in background to those in the experiment.

Niedermeyer (1974) assessed the effectiveness of a handwriting program, consisting of tracing and copying model letters or numerals, on kindergarten children's legibility and attitude toward writing. The program involved letter formation exercises in which the children traced and then copied model letters or numerals. The investigator reported that the sequenced systematic program had a positive effect on both handwriting legibility and students' attitude toward handwriting. It should be noted the children received direct positive teacher feedback throughout the year-long program.

Several other researchers have advocated copying as the preferred technique for teaching handwriting including Sovik (1979), Wright and Wright (1980), Kirk (1980, and Hayes (1982). In fact, Kirk (1980)
states that "... empirical evidence [shows] that copying is more effective than tracing as a technique for introducing beginners to handwriting" (p. 29). She further stated:

Copying is a widely used method of handwriting instruction. Tracing might well be eliminated as a preliminary step (p. 33).

However, it would seem more useful for teachers to employ either copying, tracing, or physical guidance based upon the situation and child. A suggested method of instruction might be to utilize copying from a model first. If this fails to increase handwriting skills of individual children, a teacher should not hesitate trying a faded tracing activity. Finally, if both copying and tracing have failed to produce the desired results, manual guidance or physical prompting may be useful to initially teach letter formation.

The use of antecedent techniques to promote accuracy when copying. Since copying is the preferred instructional technique of most teachers, Askov and Greff (1975) suggested that future research "focus on techniques which aid children to visualize and internalize a model which they are to copy during handwriting practice" (p. 98). Since then, a few studies have examined the use of certain antecedent techniques and their effectiveness on student performance in reproducing model forms.

Antecedent techniques, as defined by Brown, et al. (1981), . . . include interventions implemented prior to the occurrence of the student's targeted response.
These may include . . . (b) changes in teacher presentation, for instance, demonstration procedures or modeling . . . (p. 226).

Brown, et al. further define modeling as "... refer[ing] to any of a wide variety of effects of a model's behavior upon an observer" (p. 226).

Antecedent techniques which have been used to promote copying behavior include: (1) copying from a still model of letters, (2) copying letters after watching a teacher demonstrate how a letter is written (modeling), (3) copying from a model depicting motion of letter formations (motion model), or (4) copying letters using either modeling, still, or motion models plus having students self-verbalize letter formations. Three recent studies have examined these techniques.

In a study by Sovik (1976) conducted in a laboratory setting, the effects of three antecedent techniques on accuracy of copying letter-like figures were compared. The techniques examined were (1) copying letter-like figures from a still model, (2) attending to the experimenter’s hand while the figure was drawn and then copying the figure (modeling), and (3) listening to detailed explanations of the formation of the figure while the experimenter drew the figure and then copying the figure (modeling plus verbal explanations). The subjects were twenty-four eight-year olds. Sovik reported increased accuracy scores were shown for subjects progressively through the treatments with modeling plus verbal explanations increasing accuracy the greatest. It was suggested that the combined demonstration-verbal technique has powerful consequences on handwriting.
Hayes (1982) compared the effects of five antecedent techniques on student performance in reproducing twelve letter-like forms. Subjects for this study consisted of 45 six-year old kindergarten children and 45 nine-year old third grade children. The children were randomly assigned to one of five conditions which were: 1) control (no treatment) (A), 2) copying from a still model (B), 3) visual demonstration (teacher modeling) of the formation of letter-like forms (C), 4) visual demonstration and verbal description of the formation of letter-like forms (D), and 5) visual demonstration, verbal description, and subject verbalization of letter-like forms (E) (students verbalized to themselves the stroke sequence of letter-like forms). An analysis of variance showed that letter-like formation accuracy increased within the conditions in the following manner:

   Kindergarten:  E > D > C > B = A
   Third Grade:  E > D < C > B < A

Results showed that the mean accuracy score occurring under the visual demonstration (modeling), verbal description, plus verbalization condition was significantly higher than the means of any other condition in both groups. For both groups, the use of the still model ranked lowest in producing accuracy. It was suggested that the combination of teacher modeling, verbal description, and self verbalization is the most productive teaching strategy when introducing letters to students.

In the only study which reported the effects of using models depicting motion of letter formations, Wright and Wright (1980)
compared the effectiveness of copying from a still model of letters and a motion model on the manuscript letter formation of 120 first grade students. Flipbook devices for lowercase manuscript letters were developed and used by one group of students to depict letter stroke movement. As a student flipped through the book, the given letter appeared in a manner similar to an animated cartoon. An illustration of the flipbook appears in Figure 1.

Traditional still models of letters were given to subjects in the still group. Statistical tests showed that the motion group performed significantly better than the still group on the posttest measuring legibility and letter formation. The authors suggest that because copying results were improved by using the flipbooks, one viable way to improve copying results is through a motion model.

It must be noted, however, that no precise description of lessons and instructional time was provided by the experimenters, therefore, making it difficult to assess the strengths of either treatment. Also, the use of flipbooks to depict the motion pattern for letter formation may not be the most highly refined method of depicting letter formation.

It would appear, based on the preceding three studies, that the least effective antecedent technique in promoting student performance in reproducing model forms is the still model. Based on Sovik's and Hayes' studies, teacher modeling with verbal descriptions of letter formation appear to produce a higher degree of performance than modeling alone. When student verbalization of letter formation (Hayes)
Figure 1. Use of Flipbook Model*

was added to modeling and directions, an even higher degree of accuracy was reported.

The use of a motion model appears to be a promising antecedent technique in promoting copying behavior, however, further research is needed in this area.

Summary

In spite of the utilitarian aspects of handwriting and its frequency of use, few teachers have well planned programs for the diagnosis and remediation of handwriting difficulties (Herrick & Okada, 1963). Of the programs in operation, handwriting is usually taught five times a week in grades kindergarten through four and three times a week in grades five to eight. Only one school in five attempts to individualize handwriting instruction. Curricula usually consists of teaching both manuscript and cursive styles of writing, making the transition to cursive at approximately the end of second grade or the beginning of third grade. The major factors emphasized in most curricula are those of legibility (correctness of letter formation) and proficiency (rate and fluency). The most widely used evaluative instruments measuring legibility are handwriting scales which, generally, are highly subjective and unreliable. Objective evaluative instruments have been developed by Helwig, et al. (1976) and shown to be reliable in measuring legibility.

Methodological procedures in handwriting instruction often characterize possible variables affecting children's handwriting which teachers feel are important. The use of process-based instruction has been advocated by Hebb (1949), Furner (1969), Gerard and
Junkala (1980), and Hayes (1982) among others while product or sub-
skill teaching has been emphasized by Barbe (1974), Lovitt (1977),
Stephens (1977), Cieslicki (1980), Hartley (1980), Milone and
Wasylyk (1981) and others. Other major variables effecting children's
handwriting are physical development, body part positioning, speed
and stress, handwriting instruments, and writing surfaces.

The most common instructional techniques used in the teaching of
handwriting include manual guidance, tracing, and copying, combined
with reinforcement and informational feedback. Several research
studies provide evidence that handwriting skills increase as a function
of contingency management or visual or verbal feedback (Fauke, et al.,
Manual guidance (physical prompting) is often used by teachers as an
instructional technique in the beginning stages of handwriting. Recent
research supports the contention that copying from a model is more
effective as an instructional technique than tracing in handwriting
instruction (Askov & Greff, 1975; Hirsch, 1973; Hirsch & Niedermeyer,

Concerning the use of antecedent techniques to promote accuracy
when copying, recent studies have compared four techniques including
the use of still models, motion models, teacher modeling, and student
verbalization of letter formations. Most studies support the conten­
tion that modeling combined with verbal instruction is more effective
than modeling alone or copying from a still model (Hayes, 1982;
Sovik, 1976). In the only study examining the effects of a motion
model, Wright and Wright (1980) found the use of a motion model more effective than a still model on increasing legibility and letter formation of first grade students. No research to date has compared the differential effects of modeling, still models, and motion models on letter formation in any one experiment. Further research is needed concerning the use of these antecedent techniques in handwriting instruction.
Chapter III

METHODS AND PROCEDURES

Purpose

The purposes of this study were: first, to compare the differential effects of using three antecedent techniques (Still Illustration, Motion Illustration, and Modeling plus Verbal Directions) to promote copying behavior of kindergarten students’ lower-case manuscript letter formations to determine whether any technique would increase the percentage of accuracy of letter formations. Second, to determine if any antecedent technique would clearly demonstrate the greatest increase in the percentage of letter accuracy. Third, to determine if any antecedent technique would demonstrate a functional relationship (experimental control) between letter formation accuracy and the technique. This would be determined by a differential effect of treatment demonstrated by one technique over the others. Fourth, to assess whether an increase in accuracy of lower-case manuscript letters written in isolation during an intervention would transfer to a similar level of accuracy for that set of letters written in context of words in a sentence.

Subjects

The classroom was selected after describing the nature of the study to the director of a preschool program whose preschool was
close to The Ohio State University. A kindergarten class was selected for the purposes of the study. Criteria for selection were the cooperation and interest of the kindergarten teachers and program director.

Subjects consisted of fourteen kindergarten students attending the preschool program. Ages ranged from five to six years. The subjects were selected on the following criteria:

1. Expressed interest and cooperation of both teachers and program director.
2. Students who had not formally been introduced to manuscript handwriting with the exception of writing their name.
3. Students who received written parental consent to participate.

**Parental Approval**

After receiving an expressed interest by the program director and both teachers, the experimenter explained the purpose of the study in a cover letter and asked the teachers to distribute the letters to their students' parents. All letters were distributed to the students' parents. Attached to the cover letter was a parental consent form which, when signed by the parents, allowed the child to participate in the study. All students received written parental permission to participate in the study. For a copy of the cover letter and consent form refer to Appendix C.
Setting

The study took place in a kindergarten class contained within an urban preschool program located in Columbus near The Ohio State University. The subjects worked at their table area in the classroom. When the experimenters arrived at the classroom, the teachers instructed the students to go to their designated areas for handwriting instruction. The students were seen five sessions per week at 11:00 a.m. each school day. The length of each session was approximately twenty minutes. The work surface of the student was void of objects except for the students' handwriting materials: writing implement, paper, and model letters when appropriate.

Materials

Still Illustration Letters

The subjects used one training sheet of nine lower-case manuscript letters developed from the Zaner-Bloser Creative Growth Manuscript Alphabet (1974). The letters f, a, q, l, n, s, t, w, and z constructed with a line weight of one millimeter were printed on paper by the Zaner-Bloser Company with sets of parallel lines. The spaces between the headline and midline, midline and baseline, and descender space below the baseline were seven-sixteenths of an inch (1.11 centimeters). A copy of the training sheet is included in Appendix D.

Copy Paper

Writing Paper Number 1, published by the Zaner-Bloser Handwriting Company for use with grade one and two, was used. Spacing between
the lines was seven-sixteenths of an inch (1.11 centimeters) between the headline and midline, midline and baseline, and descender space below the baseline. The paper for copying letters measured eight and one-half inches (21.59 centimeters) by eleven inches (27.94 centimeters) and contained red and green parallel lines. A photocopy of the copy paper is included in Appendix E.

**Evaluative Overlays**

A set of transparent overlays designed by Helwig, Johns, Norman, and Cooper (1976) was used to measure deviations of student samples from model letters. Helwig designed the overlays to measure three ranges of deviations of student samples from model letters (zero to one millimeter, zero to two millimeters, and zero to three millimeters). For the purposes of this study, the overlays measuring deviations from zero to one millimeter were used. An illustration of one overlay is included in Appendix F. (For a detailed description of overlays, see Helwig, et al., 1976).

**Writing Implements**

Zaner-Bloser Standard Pencils were used during all conditions by the students.

**Motion Overlays and Adaptor**

A set of overlays designed by the Educational Dynamics Corporation to provide moving illustrations of manuscript letter formation (Photo-Motion) were used during the Motion Illustration Condition. These animated overlays were developed for use with an overhead projector using a specially designed adaptor. The overlays displayed letters
of the alphabet while demonstrating, through continually moving strokes, the direction of each stroke used in the formation of letters. An illustration of one overlay is included in Appendix G.

Chalk

Green and red chalk were used during the Modeling plus Verbal Directions Condition to draw parallel lines on a blackboard which were similar in color to the parallel lines on the student's copy paper.

Overhead Projector

Recording Forms

Three recording forms (one for each condition) were used to record correct and incorrect letter strokes written by each student during each session. Each recording form contained eight or nine model letters which represented letter families included in the Zaner-Bloser Creative Growth Manuscript Alphabet (1974).

Behavior Definition and Recording*

The following criteria were used to define correct manuscript letter strokes:

1. The total stroke must be within the confines of the line of the overlay.

Example: Yes ( ) No ( )

*The following section is taken directly from Helwig, et al., 1976, with the authors' permission.
2. Each stroke that is not a complete circle must begin and end between the small slash mark and in the line forming the confines of the letter. (Each stroke must measure the length specified by the small slash marks, but does not necessarily have to intersect the slash marks.)
Example: Yes ( ) No ( )

3. All circles in the letters a, b, d, g, o, p, q and the top of the letter e must be closed curves.
Example: Yes ( ) No ( )

4. All strokes must intersect each successive stroke at one point except for the dot above the i and j.
Example: Yes ( ) No ( )

5. The letter must be complete with all strokes present.
Example: Yes ( ) No ( )

6. The horizontal stroke in the t and f must intersect the other stroke within the confines of the ellipse near the center of the vertical stroke.
Example: Yes ( ) No ( )

Recording strokes meeting these criteria requires correct usage of evaluation overlays. The placement of the letter boundaries on the evaluation overlays were positioned to match the placement of the model letters on the training sheet both horizontally and vertically. To establish the correct vertical placement of the
overlays, the four parallel broken lines of each set of five letter boundaries were placed directly over the guidelines for the same sets of five model letters on the subject's handwriting samples. Horizontal placement was determined by two factors, position of letters on subject's sample and accuracy in copying the model letter. The overlay was moved to the left or right keeping the broken lines directly over the guidelines on the subject's sample until all strokes of the letter were within the boundary of the evaluation overlay. When horizontal movement of the overlay would not assist in bringing all strokes of a letter within the boundary of that letter, then the horizontal placement was determined by the position which brought the greatest number of letter strokes within the boundary of the evaluation instrument.

A recording sheet was developed listing the ten model letters down the left side of the page . . . Each letter included graphical pictures of the strokes used to construct the letter beside it with blanks to record the strokes meeting criteria. The evaluation overlay was used to measure the first letter of the subject's handwriting sample using all of the six criteria pertaining to the letter. Each letter stroke meeting criteria was recorded.
with a (✓) beside the graphical representation of the stroke. The evaluator measured the second letter and recorded the correct strokes, etc., until all ten sample letter strokes were measured and recorded.

Each student's sample of handwriting was evaluated using the procedures outlined by Helwig, et al. (1976). A checkmark (✓) was recorded on the recording form under the sample number and by the appropriate stroke if the stroke on the student's sample was correct. A minus sign (−) was recorded if the stroke was incorrect. In addition, the following criteria were used to score certain letter strokes:

1. Letters consisting of two strokes in which each stroke might have been scored as ✓ or - depending upon the horizontal positioning of the overlay, were scored as (✓).

Example: 

```
   | o or l
```

2. Letters consisting of three or four strokes in which strokes may be scored as ✓ or - depending upon the horizontal positioning of the overlay, will be scored by:

A) Accepting the greatest amount of correct strokes possible.
Example: \[ \hat{W} = (\checkmark) \quad \hat{K} = (\checkmark) \]

B) Accepting the initial correct strokes possible
when a letter can be scored as \( \checkmark \) or \( \bar{\checkmark} \) or as \( \bar{\checkmark} \) or \( \bar{\bar{\checkmark}} \).

Example: Yes
\[ \hat{W} = (\checkmark) \quad \hat{W} = (\checkmark) \]
Yes
\[ \hat{Z} = (\checkmark) \quad \hat{Z} = (\checkmark) \]

Design
The study employed a multielement design (Ulman & Sulzer-Azaroff, 1975). This design allows for the repeated measurement of a behavior (manuscript letter formation) under alternating conditions of the independent variable (interventions). A baseline (no treatment) condition of six sessions preceded the experimental phase (treatments) when alternating conditions were interspersed—on an unpredictable schedule—throughout the study. Conditions for this study were altered randomly from session to session. The multielement design was especially useful for analyzing the effects of the three treatments on the dependent variable since a distinctive (potentially discriminative) stimulus was correlated with each intervention and the effects of the intervention were observed by comparing differential performances.
Experimental control was demonstrated when different patterns of responding developed, and each pattern was observed to be unique to a particular experimental condition. Because each treatment was presented in alternation on a random schedule, confounding sequential effects were eliminated as a threat. Each treatment was presented for six sessions throughout the study. The three treatments that were incorporated throughout the study were Modeling plus Verbal Directions, Still Illustration, and Motion Illustration. Figure 2 illustrates a hypothetical example of the design.

Figure 2. Hypothetical Example of Multielement Design.
Design Conditions

Baseline (pretest)

Initially, six sessions of baseline data were collected for each student to determine the level of accuracy of lower-case manuscript letter formations prior to interventions. The experimenter trained the kindergarten teachers to collect baseline data in order to avoid subject reactivity to the experimenter during this condition. Teachers were trained to implement the following procedure:

Before beginning each session, the teacher took one to three minutes to exchange some form of verbal interaction with the students to increase the chance that they would feel at ease. Each student was then given a sheet of copy paper, a writing implement, and a baseline probe sheet of model letters (lower-case manuscript, a through z). The teacher then explained to the students that she would like them to write each letter only once and to do their best to make it look like the model letter. After all of the letters were copied, the teacher asked the students to write their name on the paper, thanked the students for working, and collected their papers and pencils. The teacher then wrote the date on each paper. At no time was any instruction or corrective feedback offered to the students during baseline. Also, at
no time did the teacher offer any editorial or evaluative information regarding the quality of work by any student.

At the conclusion of each school day in which baseline data had been collected, the experimenter received the student samples for scoring. Upon completion of collecting and measuring baseline data, interventions began.

**Interventions**

Interventions consisted of the presentations of the antecedent techniques (conditions). Conditions were altered randomly from session to session and presented for a total of six sessions each throughout the eighteen session intervention phase.

**Modeling Plus Verbal Directions**

The experimenter, using a four line chalk holder with red and green chalk, drew lines on a chalkboard which corresponded with lines on the student's copy. The experimenter then talked to the group of students for several minutes using some form of verbal interaction to increase the chance that the students felt at ease. For example, "I'm delighted to be here today. I can see that you are students who listen carefully and follow directions." The students were then given a sheet of copy paper and a writing implement. Each sheet of copy paper had a star drawn on the upper left corner of the paper. The experimenter asked the students to write their name on the top of the paper next to the star. He then explained to the students that he was going to write a letter on the board. Students
were instructed to put their pencils down and watch the experimenter write the letter on the chalkboard. The experimenter then wrote one letter on the board while providing simple verbal directions to the students regarding the formation of letter strokes. For example, "When writing the letter d, begin a little below the thin green line and draw a circle like this" (experimenter drew circle). "As you can see, the circle is connected. Then, starting on this thick green line, draw a straight line down, touching the circle, and stop on the red line" (experimenter drew line). The experimenter then asked the students to write the letter on their paper only once and do their best to make it look like the model letter on the board.

After each student had copied the letter, it was erased from the board. This procedure continued until the following letters had been written: d, e, g, k, l, r, v, and h. When all the students had finished, the experimenter thanked the students for working, collected the papers and pencils, and left the classroom. The experimenter then wrote the date and condition on each paper. At no time did the experimenter offer any editorial or evaluative information regarding the quality of work by any student. The experimenter then scored the percentage of correct strokes for each student and plotted the appropriate data on student graphs.

**Motion Illustration**

The experimenter talked to the students in a group setting for several minutes informally to increase the chance that the students would feel at ease. The students were then given a sheet of copy
paper and a writing implement. The experimenter asked the students to write their name on the top of the paper next to the star, then put their pencils down and listen. The experimenter then explained that the overhead projector would show a letter for them to copy and that the machine would demonstrate how to form each letter. The students were told to watch the moving strokes in each letter which indicated how to form each letter. The experimenter then demonstrated, by using the upper-case letters E and Q, how the animated overlay displayed the formation of letter strokes. The experimenter then placed the overlay containing the first model letter on the adapted projector and turned it on. Students were asked to copy the letter only once and do their best to make it look like the model letter on the overhead display. When all students had copied the letter, the experimenter removed the overlay and placed the overlay containing the next letter to be copied on the adapted projector. The procedure continued until the following letters had been copied: b, c, j, o, m, p, x, y, and u. When all of the students had finished, the experimenter thanked the students for working, collected the papers and pencils, and left the classroom. The experimenter then wrote the date and condition on each paper. At no time did the experimenter offer any editorial or evaluative information regarding the quality of work by any student. The experimenter then scored the percentage of correct strokes for each student and plotted the appropriate data on student graphs.
The experimenter talked to the group of students for several minutes informally to increase the likelihood that the students would feel at ease. Then, each student was given a writing implement, a sheet of copy paper, and a sheet of model letters. Students were asked to write their name on the top of the paper next to the star, then put their pencils down and watch. The experimenter then explained to the students that they should follow the arrows and numbers on the model letters and write each letter by drawing the strokes by following the numbers and arrows. He then demonstrated this procedure by using the upper-case letters E and Q placed on an overhead projector for the first two sessions. Demonstrations did not occur for the remaining sessions. The students were then asked to copy the following letters: f, a, q, l, n, s, t, w and z only once, and to do their best to make each letter look like the model letters. When students were finished, the experimenter checked to make sure that each of the letters had been copied, thanked the students for working, collected their papers and pencils and left the classroom. The experimenter then wrote the date and condition on each paper. At no time did the experimenter offer any editorial or evaluative information regarding the quality of work by any student. The experimenter then scored the percentage of correct strokes for each student and plotted the appropriate data on student graphs.
Letters Written In Context

During in context handwriting, students were given a model sheet containing the three sets of lower-case manuscript letters used during the interventions. The letters were written in context of words in the sentence, "The quick fox jumps over the lazy brown dog." Three sessions of data were collected. The students were instructed to copy all of the letters and words as they saw them in the sentence on the lines provided for them on the model sheet below the sentence. No demonstration of letter formations or instructions on how to copy the letters were offered by the experimenters. When all students had copied the sentence, the experimenter thanked the students for working, collected the papers and pencils, and left the classroom. The experimenter then wrote the date and condition on each paper, scored the percentage of correct strokes for each set of letters for each student, and plotted the appropriate data on student graphs. A copy of the in context handwriting sheet is included in Appendix H.

Assignment of Letters

Letters in each treatment condition represented families of letters described by the Zaner-Bloser Creative Growth Manuscript Alphabet (1974). Eight or nine different letters were selected for each condition. The assignment of letters to each condition was determined by analyzing baseline data which indicated the mean percent of correct strokes for a set of model letters for the group of students. The three sets of model letters assigned for intervention
purposes did not differ in accuracy of letter formation by more than three percentage points for the group, thus controlling for pretest differences.

Training of Experimenter

Two experimenters were trained by the principle experimenter to present the three antecedent techniques. The principle experimenter, following the procedures specified in the section on design conditions, role modeled the presentation of each conditions with the experimenters. A checklist containing the major components of each presentation was given to the experimenters to use as a prompt during the interventions and to serve as a further aid to consistency of presentations between the experimenters.

Data Analysis

Data from experimental conditions were measured and recorded by the researcher using the evaluative overlays by Helwig, et al. (1976) and recording sheets. Each student's sample of handwriting was evaluated using the procedures outlined in the section on Behavior Definition and Recording.

The sum of correct strokes per sample was divided by the total strokes possible and multiplied by 100. The percentage of correct strokes was graphed per session for each subject during all conditions. The mean percentage of correct strokes per session for the entire group was also graphed. The data were analyzed using measures of central tendency (mean and range), checking for experimental control.
and by calculating regression lines. Control occurred when different patterns of responding developed which were observed to be unique to a particular treatment. The degree of control was demonstrated by the vertical distance between the curves on the graph.

**Interobserver Agreement Measures**

**Dependent Variable**

Interobserver agreement was calculated by dividing the number of agreements of two evaluators on any one particular student sample by the sum of agreements plus disagreements and multiplying by 100 (Cooper, 1981). The following procedure was used to obtain interobserver agreement:

1. Two evaluators were trained to use the evaluative overlays and record correct responses after measuring subject handwriting samples. These evaluators were given a subject's handwriting sample, an evaluation overlay, a recording sheet, and a letter criterion sheet. An explanation of the letter criterion sheet was done by the researcher by demonstrating all types of errors letter strokes might exhibit when not meeting the predetermined criterion. The evaluators were shown the correct procedure when placing the evaluation overlay over a
subject's sample and how to shift it horizontally to bring the letter to be evaluated within the parameters of the overlay. The experimenter demonstrated the use of the recording sheet by evaluating letter strokes of one subject's sample and recording all correct responses. The evaluators practiced using the evaluative overlay and recording correct responses until each met an eighty-five percent agreement with the researcher. Once both evaluators' responses met the agreement criteria of eighty-five percent or better, actual interobserver agreement began.

(2) Interobserver agreement checks were taken during each condition of the study, with the exception of baseline condition.

(3) Interobserver agreement scores were obtained by having one of the evaluators measure and record the number of correct letter strokes on a subject's sample and compare results with the experimenter's results for the same sample using the formula mentioned in the opening paragraph of this section: \[
\frac{\text{Agreements}}{\text{Agreements + Disagreements}} \times 100.
\]

Additionally, interobserver agreement measures for the samples included:

1. dividing the total number of agreements for correct strokes by the sum of disagreements plus agreements
for correct strokes and multiplying by 100; and

2. dividing the total number of agreements for incorrect strokes by the number of agreements plus disagreements on incorrect strokes and multiplying by 100.

An average interobserver agreement score of eighty-five percent was required throughout the study. If agreement did not meet or maintain this score, the procedures and criterion would have been redefined and practiced until the eighty-five percent was met.

**Control for Differential Treatment**

The following steps were taken to help control against contamination of data due to differential experimenter treatment between the experimenters and subjects. First, the experimenters were trained to present the antecedent techniques in the manner specified in the previous section on Design Conditions. Secondly, each experimenter presented each intervention at least once throughout the study, thus mixing experimenters with each level of the independent variable. In addition, at least one audiotaped cassette recording was made of each experimenter during each condition of the study with the exception of one recording which failed due to technical difficulties. The tapes were then examined by two evaluators using a checklist containing the seven major components of each method of presentation. Appendix I contains a copy of each checklist. A plus sign (+) was recorded to the left of each component if it was exhibited, while a minus sign (-) was recorded if the component was missing. These data were treated in the following manner.
Presentation Accuracy

The percentage of components exhibited by each experimenter during the presentation of a condition was calculated by dividing the total number of components involved in the presentation (7) into the number of components exhibited by the experimenter and multiplying by 100. The obtained percent score indicated the completeness of the experimenter's presentation.

Presentation Interobserver Agreement Measures

Two evaluators listened to each taped presentation and calculated an interobserver agreement score by dividing the total number of their agreements by the sum of agreements plus disagreements and multiplying by 100. The obtained percent score indicated the degree of agreement for two evaluators on an experimenter's presentation.

Consistency of Presentations Between Experimenters

A consistency score between the three experimenter's presentations for each condition was to be obtained by subjecting the data from the tapes to a non-parametric test. However, because all presentations scored were 100 percent accurate and 100 percent consistent with each other, treating the data statistically was not necessary. Scores were reported as percentage of presentation accuracy and consistency.
Chapter IV
PRESENTATION, ANALYSIS, AND DISCUSSION OF DATA

The effects of three treatments were measured by an instrument designed to record changes in lower case manuscript letter formations. The instrument measured maximum deviations of one millimeter from 26 model lower case manuscript letters. The letters were divided into three sets each containing eight or nine different letters representing letter families described by the Zaner-Bloser Creative Growth Manuscript Alphabet (1974). One set of letters was assigned to each treatment. Manuscript letter samples were obtained from fourteen kindergarteen children. Selected student samples are contained in Appendix J. During each session of the baseline condition, each student was asked to copy all 26 manuscript letters in isolation. These data were collected to determine the level of accuracy for lower case manuscript letter formations prior to intervention.

During each session of the treatments, each student was asked to copy one set of letters in isolation assigned to one particular treatment. Treatments were altered randomly throughout 18 sessions. Upon completion of intervention, each student was asked to copy all 26 manuscript letters written in a sentence to determine transfer of letter accuracy from letters written in isolation to letters written in context. Three individual recording sheets were used to record
correct and incorrect letter strokes written by each student for each session during each condition. A group recording sheet was used to record and compute group mean percentage of correct letter strokes for each session during each condition.

**Interobserver Agreement**

Interobserver agreement measures of data recording were taken during the intervention conditions and for letters written in context. The trained independent observer measured each student's handwriting samples and recorded the letter strokes as correct or incorrect on an individual recording sheet. The two recording sheets were compared to determine the number of responses that agreed (were scored the same) and the number of responses that disagreed (were scored differently). Percentage of interobserver agreement was calculated using the formula stated below.

\[
\text{Percentage of Agreement} = \left( \frac{\text{Number of Agreements}}{\text{Number of agreements} + \text{Number of disagreements}} \right) \times 100
\]

The percentages of agreement for the interventions during which the interobserver agreement measures were taken are presented in Table 2. Fourteen samples of each condition were subjected to an interobserver agreement measure. During the Still Illustration Condition, agreement ranged from 89 percent to 100 percent with a mean of 96 percent. During Motion Illustration Condition, agreement ranged from 82 percent to 100 percent with a mean of 95 percent. During the Modeling Condition, agreement ranged from 71 percent to 100 percent.
Table 2
Mean Percentage and Range of Interobserver Agreement
for Motion Illustration, Still Illustration, and Modeling Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of Samples Scored</th>
<th>Highest Agreement</th>
<th>Lowest Agreement</th>
<th>Mean Percentage of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still Illustration</td>
<td>14</td>
<td>100</td>
<td>89</td>
<td>96</td>
</tr>
<tr>
<td>Motion Illustration</td>
<td>14</td>
<td>100</td>
<td>82</td>
<td>95</td>
</tr>
<tr>
<td>Modeling</td>
<td>14</td>
<td>100</td>
<td>71</td>
<td>96</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
<td>71</td>
<td>95.7</td>
</tr>
</tbody>
</table>
with a mean of 96 percent. Overall interobserver agreement for the 42 samples ranged from 71 percent to 100 percent with a mean of 95.7 percent.

Fourteen samples for each set of letters written in context were scored. The percentages of agreement for each set of letters written in context are presented in Table 3. Interobserver agreement for the set of letters previously paired with the Still Illustration Condition ranged from 89 percent to 100 percent with a mean of 95.4 percent. For the set of letters previously paired with the Motion Illustration Condition, agreement ranged from 82 percent to 100 percent with a mean of 94.4 percent. For the set of letters previously paired with the Modeling Condition, agreement ranged from 82 percent to 100 percent with a mean of 92.6 percent. Overall, interobserver agreement for letters written in context ranged from 82 percent to 100 percent with a mean of 94.1 percent.

Additional interobserver agreement measures were made on the strokes recorded as correct and those recorded as incorrect for all fourteen students during each condition. The percentage of agreement for correct strokes was computed by dividing the total number of agreements for correct strokes by the sum of agreements plus disagreements on correct letter strokes and multiplying by 100 percent. The percentage of interobserver agreement on correct letter strokes for each treatment is presented in Table 4. During the Still Illustration Condition, agreement on correct strokes ranged from 75 percent to 100 percent with a mean of 93 percent. During the
Table 3
Mean Percentage and Range of Interobserver Agreement
for Letters Written In Context

<table>
<thead>
<tr>
<th>Letter Sets</th>
<th>Number of Samples Scored</th>
<th>Highest Agreement</th>
<th>Lowest Agreement</th>
<th>Mean Percentage of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still Illustration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Letters</td>
<td>14</td>
<td>100</td>
<td>89</td>
<td>95.4</td>
</tr>
<tr>
<td>Motion Illustration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Letters</td>
<td>14</td>
<td>100</td>
<td>82</td>
<td>94.4</td>
</tr>
<tr>
<td>Modeling Letters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>100</td>
<td>82</td>
<td>92.6</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
<td>82</td>
<td>94.1</td>
</tr>
</tbody>
</table>
Table 4
Mean Percentage and Range of Interobserver Agreement on Correct Strokes for Motion Illustration, Still Illustration, and Modeling Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of Samples Scored</th>
<th>Highest Agreement</th>
<th>Lowest Agreement</th>
<th>Mean Percentage of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still Illustration</td>
<td>14</td>
<td>100</td>
<td>75</td>
<td>93</td>
</tr>
<tr>
<td>Motion Illustration</td>
<td>14</td>
<td>100</td>
<td>60</td>
<td>91</td>
</tr>
<tr>
<td>Modeling</td>
<td>14</td>
<td>100</td>
<td>50</td>
<td>94</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
<td>50</td>
<td>92.7</td>
</tr>
</tbody>
</table>
Motion Illustration Condition, agreement on correct strokes ranged from 60 percent to 100 percent with a mean of 91 percent. During the Modeling Condition, agreement on correct strokes ranged from 50 percent to 100 percent with a mean of 94 percent. Overall agreement for all 42 samples during intervention ranged from 50 percent to 100 percent with a mean of 92.7 percent.

The percentage of interobserver agreement on correct strokes for each set of letters written in context is presented in Table 5. For the set of letters previously paired with the Still Illustration Condition, agreement on correct strokes ranged from 82 percent to 100 percent with a mean of 92.7 percent. For the set of letters previously paired with the Motion Illustration Condition, agreement on correct strokes ranged from 0 percent to 100 percent with a mean of 84.8 percent. For the set of letters paired with the Modeling Condition, agreement on correct strokes ranged from 50 percent to 100 percent with a mean of 86 percent. Overall agreement for all 42 samples ranged from 0 percent to 100 percent with a mean of 87.8 percent.

The percentage of agreement on incorrect strokes was calculated by dividing the total number of agreements on incorrect strokes by the total number of agreements plus disagreements on incorrect strokes and multiplying by 100 percent. The percentage of interobserver agreement on incorrect strokes during each treatment is summarized in Table 6.

During the Still Illustration Condition, agreement on incorrect strokes ranged from 90 percent to 100 percent with a mean of 98 percent.
Table 5
Mean Percentage and Range of Interobserver Agreement on Correct Strokes for Letters Written In Context

<table>
<thead>
<tr>
<th>Letter Sets</th>
<th>Number of Samples Scored</th>
<th>Highest Agreement</th>
<th>Lowest Agreement</th>
<th>Mean Percentage of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still Illustration Letters</td>
<td>14</td>
<td>100</td>
<td>92</td>
<td>92.7</td>
</tr>
<tr>
<td>Motion Illustration Letters</td>
<td>14</td>
<td>100</td>
<td>0</td>
<td>84.8</td>
</tr>
<tr>
<td>Modeling Letters</td>
<td>14</td>
<td>100</td>
<td>50</td>
<td>86.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
<td><strong>100</strong></td>
<td><strong>0</strong></td>
<td><strong>87.8</strong></td>
</tr>
</tbody>
</table>
Table 6

Mean Percentage and Range of Interobserver Agreement on Incorrect Strokes for Motion Illustration, Still Illustration, and Modeling Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of Samples Scored</th>
<th>Highest Agreement</th>
<th>Lowest Agreement</th>
<th>Mean Percentage of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still Illustration</td>
<td>14</td>
<td>100</td>
<td>90</td>
<td>98</td>
</tr>
<tr>
<td>Motion Illustration</td>
<td>14</td>
<td>100</td>
<td>83</td>
<td>97</td>
</tr>
<tr>
<td>Modeling</td>
<td>14</td>
<td>100</td>
<td>82</td>
<td>97</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
<td>82</td>
<td>97.3</td>
</tr>
</tbody>
</table>
During the Motion Illustration Condition, agreement on incorrect strokes ranged from 83 percent to 100 percent with a mean of 97 percent. During the Modeling Condition, agreement on incorrect strokes ranged from 82 percent to 100 percent with a mean of 97 percent. Overall interobserver agreement on incorrect strokes for all 42 samples ranged from 82 percent to 100 percent with a mean of 97.3 percent.

The percentage of interobserver agreement on incorrect strokes for each set of letters written in context is presented in Table 7. For the set of letters previously paired with the Still Illustration Condition, agreement on incorrect strokes ranged from 89 percent to 100 percent with a mean of 97 percent. For the set of letters previously paired with the Motion Illustration Condition, agreement on incorrect strokes ranged from 83 percent to 100 percent with a mean of 95 percent. For the set of letters previously paired with the Modeling Condition, agreement on incorrect strokes ranged from 83 percent to 100 percent with a mean of 98.2 percent. Overall agreement for all 42 samples ranged from 83 percent to 100 percent with a mean of 96.7 percent.

Control for Differential Treatment

One audiotape cassette recording was made by each of the three experimenters during one presentation of the Still Illustration Condition, Motion Illustration Condition, and Modeling Condition. The tapes were examined by two evaluators using a checklist containing the seven major components of each method of presentation. Tapes were
<table>
<thead>
<tr>
<th>Letter Sets</th>
<th>Number of Samples Scored</th>
<th>Highest Agreement</th>
<th>Lowest Agreement</th>
<th>Mean Percentage of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still Illustration Letters</td>
<td>14</td>
<td>100</td>
<td>89</td>
<td>97.0</td>
</tr>
<tr>
<td>Motion Illustration Letters</td>
<td>14</td>
<td>100</td>
<td>83</td>
<td>95.0</td>
</tr>
<tr>
<td>Modeling Letters</td>
<td>14</td>
<td>100</td>
<td>83</td>
<td>98.2</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100</td>
<td>83</td>
<td>96.7</td>
</tr>
</tbody>
</table>
scored for presentation accuracy (completeness of presentation) and consistency of method of presentation between the experimenters for each condition. Interobserver agreement on each experimenter's presentation was also calculated between the two evaluators. Tapes were obtained for eight presentations. Due to mechanical difficulties, one audiotaped presentation was not available for scoring. During all conditions, each experimenter scored 100 percent on completeness of presentation. The consistency score between the three experimenters for each condition presentation was also 100 percent. Interobserver agreement between the two evaluators was 100 percent. No differences in presentation between the experimenters were detected for any condition.

Presentation and Analysis of Data

Manuscript handwriting samples for each condition were obtained from fourteen students and measured using evaluative overlays. Data were recorded and graphed per session as percentage of correct manuscript letter strokes for each student during all conditions except baseline, and mean percentage of correct manuscript letter strokes for the total group during each condition.

Baseline data for three sets of lowercase manuscript letters used in the experiment were obtained from each student and analyzed to determine letter formation accuracy for each set of letters prior to intervention. Letters were divided into sets of eight or nine different letters representing letter families described by the Zaner-Bloser Creative Growth Alphabet (1974). Set one contained the letters
f, a, q, l, n, s, t, w, and z. Set two contained the letters b, c, j, o, m, p, x, y, and u. Set three contained the letters d, e, g, k, l, r, v, and h.

**Group Findings**

**Baseline.** Six sessions of baseline data were collected for each set of letters. Baseline consisted of giving a model sheet of 26 letters to students to copy. The mean percentage of correct letter strokes for set one was 30.7 percent. The mean percentage of correct letter strokes for set two was 31.5 percent. The mean percentage of correct letter strokes for set three was 29.2 percent. The greatest difference in mean percentage occurred between set two and set three which was 2.3 percent. Of the total fourteen individual students, the greatest difference in the three sets of letters was six percent or less for eleven, while three others had a difference of seven percent. Letters were randomly assigned to each condition. Letters in set one were assigned to the Still Illustration Condition. Set two letters were assigned to the Motion Illustration Condition, and set three letters were assigned to the Modeling Condition for intervention purposes.

**Still Illustration Condition.** The Still Illustration Condition consisted of giving the students a sheet of nine model letters to copy. The model letters contained arrows and numbers to indicate the direction of letter formation. Data on the mean percentage of correct manuscript letter strokes for the group were collected for six sessions. Table 8 presents the data on percentages of correct responses for the group during the Still Illustration Condition.
<table>
<thead>
<tr>
<th>Conditions</th>
<th>Number of Samples</th>
<th>Mean Percentage of Correct Letter Strokes</th>
<th>Range</th>
<th>Regression Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still Illustration</td>
<td>78</td>
<td>27.6</td>
<td>21.9</td>
<td>31.2</td>
</tr>
<tr>
<td>Motion Illustration</td>
<td>78</td>
<td>27.7</td>
<td>25.3</td>
<td>29.9</td>
</tr>
<tr>
<td>Modeling</td>
<td>78</td>
<td>42.3</td>
<td>35.3</td>
<td>51.1</td>
</tr>
</tbody>
</table>
Seventy-eight student samples of letters were scored. The mean percentage of correct responses for the group ranged from 21.9 percent to 31.2 percent with a mean score of 27.6 percent accuracy for all six sessions. A regression line summary indicated an increasing trend in performance during the six sessions (slope = .44).

**Motion Illustration Condition.** The Motion Illustration Condition consisted of displaying letters on an overhead projector using a specially designed adaptor to demonstrate, through movement, the direction of letter stroke formations. Students observed the direction of letter strokes and copied the letter. Data on the mean percentage of correct responses for the group were collected for six sessions. Table 8 presents the data on percentage of correct responses for the group during the Motion Illustration Condition.

Seventy-eight student samples of letters were scored. The mean percentage of correct responses for the group ranged from 25.3 percent to 29.9 percent with a mean score of 27.7 percent accuracy for all six sessions. A regression line summary indicated a decreasing trend in performance during the six sessions (slope = -.28).

**Modeling Condition.** The Modeling Condition consisted of experimenter demonstration of letter formation on a board plus simple verbal directions. The students watched and listened to the experimenter as a letter was written, then copied the letter. Data on the mean percentage of correct responses for the group were collected for six sessions. Table 8 presents the data on percentage of correct responses for the group during the Modeling Condition.
Seventy-eight student samples of letters were scored. The mean percentage of correct responses for the group ranged from 35.3 percent to 51.1 percent with a mean of 42.3 percent accuracy for all six sessions. A regression line summary indicated an increasing trend in performance during the six sessions (1.02).

In context handwriting. Data on each set of letters written in context of a sentence were collected for three sessions following termination of the Still Illustration, Motion Illustration, and Modeling Condition to determine whether increased accuracy for a set of letters written in isolation under each condition would transfer to letters written in context. For each session, the students were instructed to copy all twenty-six letters written in the sentence "The quick fox jumps over the lazy brown dog." The three sets of letters representing each intervention were measured and scored. Results for the group indicated that the mean percentage of correct responses for letters written in context for the set of letters trained under the Modeling Condition was 42.5 percent. For the set of letters trained under the Still Illustration Condition, the mean score was 33.8 percent. For the set of letters trained under the Motion Illustration Condition, the mean score was 32.9 percent.

Summary of Group Performance

A total of 234 student samples were obtained during the implementation of the three conditions. Seventy-eight samples were obtained and measured for each condition. Figure 3 represents the session by session mean percentages of correct responses for the group and
Figure 3. Group Mean Performance on Letter Accuracy During Non-Contextual and In Context Handwriting. Non-Contextual Letter Formations Were Generated Under Baseline Condition and Three Alternating Conditions of Still Illustration, Motion Illustration, and Modeling Plus Verbal Directions.
regression line summaries during all conditions of the experiment. Baseline measurements of student accuracy on each set of letters were similar with a mean difference of only 2.3 percent. The Modeling Condition produced the greatest increase in accuracy of manuscript letter formations with a mean percentage of 42.3 percent, as opposed to the Motion Illustration Condition mean of 27.7 percent and the Still Illustration Condition mean of 27.6 percent for a difference of 14.6 percent and 14.7 percent respectively. Regression line summaries indicated the highest increasing trend in performance during the Modeling Condition (slope = 1.02), a moderately increasing trend in performance during the Still Illustration Condition (slope = .44), and a slightly decreasing trend in performance during the Motion Illustration Condition (slope = -.28). Data for letters written in context revealed that the most accurate responses occurred for the set of letters trained under the Modeling Condition with a mean score of 42.5 percent.

**Individual Findings**

The responses of particular individual subjects produced during the Still Illustration Condition, Motion Illustration Condition, and Modeling Construction can be seen in Tables 9, 10, and 11. A maximum of eighteen handwriting samples (six for each condition) were measured for each of the fourteen subjects. All eighteen samples were obtained from six subjects, seventeen samples were obtained from four subjects, and at least fourteen samples were obtained from the remaining four.
## Table 9
Individual Summary Scores During Still Illustration Condition

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Number of Samples</th>
<th>Mean Percentage of Correct Letter Strokes</th>
<th>Range Low</th>
<th>Range High</th>
<th>Regression Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>20.1</td>
<td>10.5</td>
<td>31.6</td>
<td>.57</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>38.6</td>
<td>21.1</td>
<td>57.9</td>
<td>-1.11</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>41.0</td>
<td>26.3</td>
<td>52.7</td>
<td>1.65</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>21.0</td>
<td>10.5</td>
<td>36.8</td>
<td>1.25</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>28.9</td>
<td>15.8</td>
<td>47.4</td>
<td>-0.58</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>35.1</td>
<td>21.1</td>
<td>47.4</td>
<td>.61</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>28.4</td>
<td>10.5</td>
<td>42.1</td>
<td>.71</td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>30.7</td>
<td>21.1</td>
<td>42.1</td>
<td>-1.20</td>
</tr>
<tr>
<td>9</td>
<td>6</td>
<td>20.1</td>
<td>15.8</td>
<td>26.3</td>
<td>.63</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>20.0</td>
<td>10.5</td>
<td>31.6</td>
<td>-.61</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>28.9</td>
<td>15.8</td>
<td>42.1</td>
<td>1.32</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>60.0</td>
<td>42.1</td>
<td>84.2</td>
<td>1.45</td>
</tr>
<tr>
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<td>6</td>
<td>4.4</td>
<td>0</td>
<td>10.5</td>
<td>.44</td>
</tr>
<tr>
<td>14</td>
<td>6</td>
<td>17.5</td>
<td>5.3</td>
<td>21.1</td>
<td>-.05</td>
</tr>
</tbody>
</table>
Table 10

Individual Summary Scores During Motion Illustration Condition

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Number of Samples</th>
<th>Mean Percentage of Correct Letter Strokes</th>
<th>Range Low</th>
<th>Range High</th>
<th>Regression Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>22.3</td>
<td>11.8</td>
<td>35.3</td>
<td>.50</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>37.2</td>
<td>29.4</td>
<td>58.8</td>
<td>-1.23</td>
</tr>
<tr>
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<td>6</td>
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<td>37.3</td>
<td>45.1</td>
<td>-.07</td>
</tr>
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<td>6</td>
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<td>33.3</td>
<td>.87</td>
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<td>58.8</td>
<td>-2.36</td>
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<td>6</td>
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<td>41.2</td>
<td>58.8</td>
<td>.38</td>
</tr>
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<td>30.6</td>
<td>23.6</td>
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<td>.30</td>
</tr>
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<td>6</td>
<td>34.3</td>
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<td>-.16</td>
</tr>
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<td>6</td>
<td>15.7</td>
<td>11.8</td>
<td>23.6</td>
<td>-.66</td>
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<td>29.4</td>
<td>-1.26</td>
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<td>8.8</td>
<td>5.9</td>
<td>11.8</td>
<td>.26</td>
</tr>
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<td>5</td>
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<td>23.6</td>
<td>41.2</td>
<td>-.54</td>
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<td>6</td>
<td>6.8</td>
<td>5.9</td>
<td>11.8</td>
<td>-.16</td>
</tr>
<tr>
<td>14</td>
<td>6</td>
<td>5.9</td>
<td>0</td>
<td>11.8</td>
<td>.62</td>
</tr>
</tbody>
</table>
Table 11
Individual Summary Scores During Modeling Condition

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Number of Samples</th>
<th>Mean Percentage of Correct Letter Strokes</th>
<th>Range Low</th>
<th>Range High</th>
<th>Regression Slope</th>
</tr>
</thead>
<tbody>
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<td>1</td>
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<td>44.1</td>
<td>35.3</td>
<td>58.8</td>
<td>.26</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>67.6</td>
<td>58.8</td>
<td>76.5</td>
<td>-.21</td>
</tr>
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<td>6</td>
<td>62.7</td>
<td>47.1</td>
<td>76.5</td>
<td>1.59</td>
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<td>6</td>
<td>45.1</td>
<td>29.4</td>
<td>58.8</td>
<td>1.87</td>
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<tr>
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<td>47.0</td>
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<td>70.6</td>
<td>1.33</td>
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<td>6</td>
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<td>17.6</td>
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<td>1.97</td>
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<td>.19</td>
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<tr>
<td>12</td>
<td>6</td>
<td>51.9</td>
<td>41.2</td>
<td>64.7</td>
<td>.35</td>
</tr>
<tr>
<td>13</td>
<td>6</td>
<td>13.7</td>
<td>0</td>
<td>23.6</td>
<td>.29</td>
</tr>
<tr>
<td>14</td>
<td>5</td>
<td>21.1</td>
<td>11.8</td>
<td>35.3</td>
<td>.49</td>
</tr>
</tbody>
</table>
subjects. At least four samples of handwriting for each condition were measured for each subject. Figures 4 through 8 include the session by session percentage of correct manuscript letter strokes made by each subject along with regression lines for each of the three conditions. Figure 9 illustrates the mean percentage of correct manuscript letter strokes during each condition for individual students.

The greatest increase in the mean percentage of accuracy of manuscript letter formations occurred in the Modeling Condition for Subjects 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, and 14; Still Illustration Condition for Subjects 11 and 12; and Motion Illustration Condition for Subject 10. Regression line summaries indicated an increasing trend in performance during the Modeling Condition for Subjects 1, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13 and 14. An increasing trend in performance during the Still Illustration Condition occurred for Subjects 1, 3, 4, 6, 7, 9, 11, 12, and 13, while an increasing trend in performance occurred during the Motion Illustration Condition for Subjects 1, 4, 6, 7, 11, and 14.

A clear effect on the dependent variable was demonstrated by the Modeling Conditioning for all 18 sessions for Subjects 1, 2, 3, and 4. Effect of treatment was demonstrated for the modeling condition for the last fifteen sessions for Subjects 5 and 9, for the last twelve sessions for Subjects 6 and 7 and for the last nine sessions for Subject 8. A partial treatment effect was demonstrated for the Still Illustration Condition for Subjects 9, 11, 12, and 14, and for the
Figure 4. Individual Performance on Letter Accuracy for Subjects 1, 2, and 3 During Non-Contextual and In Context Handwriting. Non-Contextual Letter Formations Were Generated Under Three Alternating Conditions of Still Illustration, Motion Illustration, and Modeling Plus Verbal Directions.
Figure 5. Individual Performance on Letter Accuracy for Subjects 4, 5, and 6 During Non-Contextual and In Context Handwriting. Non-Contextual Letter Formations Were Generated Under Three Alternating Conditions of Still Illustration, Motion Illustration, and Modeling Plus Verbal Directions.
Figure 6. Individual Performance on Letter Accuracy for Subjects 7, 8, and 9 During Non-Contextual and In Context Handwriting. Non-Contextual Letter Formations Were Generated Under Three Alternating Conditions of Still Illustration, Motion Illustration, and Modeling Plus Verbal Directions.
Figure 7. Individual Performance on Letter Accuracy for Subjects 10, 11, and 12 During Non-Contextual and In Context Handwriting. Non-Contextual Letter Formations Were Generated Under Three Alternating Conditions of Still Illustration, Motion Illustration, and Modeling Plus Verbal Directions.
Figure 8. Individual Performance on Letter Accuracy for Subjects 13 and 14 During Non-Contextual and In Context Handwriting. Non-Contextual Letter Formations Were Generated Under Three Alternating Conditions of Still Illustration, Motion Illustration, and Modeling Plus Verbal Directions.
Figure 9. Mean Percentage of Correct Letter Strokes during Modeling Plus Verbal Directions, Still Illustration, and Motion Illustration Conditions for Subjects 1 through 14.
Motion Illustration Condition for Subjects 5 and 6. No treatment effect by any condition was demonstrated for Subjects 10 and 13.

In context handwriting. The highest mean percentage of correct responses written in context occurred for the set of letters trained under the Modeling Condition for 12 subjects. Subjects 4 and 6 scored highest for the set of letters trained under the Still Illustration Condition.

Summary of Individual Performance

The greatest increase in the mean percentage of accuracy of manuscript letter formations occurred under the Modeling Condition for eleven subjects, the Still Illustration Condition for two subjects, the Motion Illustration Condition for one subject. Regression line summaries indicated an increasing trend in performance during the Modeling Condition for twelve subjects, during the Still Illustration for nine subjects and during the Motion Illustration Condition for six subjects. The Modeling Condition demonstrated an experimental effect on student responses for nine subjects while a partial effect was demonstrated on four subjects for the Still Illustration Condition, and two subjects for the Motion Illustration Condition. No experimental effect was demonstrated by any condition for two subjects.
Chapter V

DISCUSSIONS, LIMITATIONS, IMPLICATIONS AND SUMMARY

Discussion

The purpose of this study was to examine four questions concerning the effects of different types of antecedent techniques on increasing the legibility of lowercase manuscript letters. Conclusions to the fourth research question depended heavily on the results drawn from the first three questions. Questions one, two, and three will be addressed first, followed by a discussion of question four.

1. Which, if any, of the antecedent techniques used to promote copying behavior (Modeling, Still Illustration, and Motion Illustration) will result in an increase in the percentage of correct manuscript letter strokes of kindergarten students?

2. Which antecedent technique will result in the greatest increase in the percentage of correct letter strokes of kindergarten students?

3. Will a functional relationship (experimental control) be demonstrated between any antecedent technique and student performance?
To answer these questions, the experimenters collected data (handwriting samples) on lower-case manuscript letter formations made by the students during each of the three conditions. A total of two hundred and thirty-four samples containing four-thousand one hundred and thirty-four letter strokes were collected from the fourteen students. Each sample contained eight or nine different letters which were pre-tested during baseline condition to insure equal performance of letter accuracy by the group for each set of letters prior to interventions. Group performance during baseline for the three sets of letters ranged from 29.2 percent to 31.5 percent for a greatest difference of 2.3 percent. Seventy-eight samples were measured using evaluative overlays developed by Helwig, et al. (1976) and scored individually as percentage of correct letter strokes for each sample and as mean percentage of correct letter strokes for the group for each condition.

Group data are summarized in Table 8 and illustrated in Figure 3. Group mean scores for the Still Illustration Condition ranged from 21.9 percent to 31.2 percent with a mean accuracy score of 27.6 percent. A regression line summary for the group indicated a moderately increasing trend in performance with a slope of .44. Mean scores for the Motion Illustration Condition ranged from 25.3 percent to 29.9 percent with a mean accuracy score of 27.7 percent. A regression summary indicated a slightly decreasing trend in performance with a slope of -.28. Mean scores for the Modeling Condition ranged from 35.3 percent to 51.1 percent with a mean accuracy score of 42.3 percent.
A regression line summary indicated a highly increasing trend in performance with a slope of 1.02.

The effects of the treatment procedures can be observed by comparing differential performances of the group under each condition. In this respect, an increasing pattern in responding occurred only under the Modeling Condition when compared to the Still or Motion Illustration Condition for all eighteen sessions of the experiment. This pattern of fractionation of student response demonstrates experimental control (functional relationship) between letter formation accuracy and the independent variable of Modeling. The high degree of control for the Modeling Condition is demonstrated by the vertical distance between the graphic curves representing the Modeling Condition and the Still and Motion Illustration Conditions, a difference in mean accuracy of fourteen percent. No such distinction in the pattern of responding can be observed for the Still or Motion Illustration Conditions. Visual analysis of Figure 1 reveals a lack of experimental control by either condition as demonstrated by the overlapping of graphic curves.

This consideration of condition means, ranges, experimental control and degree of control of the group data indicate that the mean percentage of correct manuscript letter strokes increased when students observed an experimenter modeling the behavior while providing simple verbal directions concerning the formation of letter strokes. No support can be given to the notion that Still Illustrations or Motion Illustrations of the letters produced an increase in letter
formation accuracy based on group data. A further verification of these results can be made by comparing Baseline Condition data and intervention data for the group which indicate a decrease in performance during the Still and Motion Illustration Conditions while a mean increase of 13.1 percent over Baseline occurred during the Modeling Condition.

Individual data are summarized in Tables 9, 10, and 11 and illustrated in Figures 4 through 9. A greater increase in the mean percentage of letter formation accuracy occurred under the Modeling Condition when compared to the Motion Illustration Condition for 13 of the 14 students. A greater increase in performance when compared to the Still Illustration Condition occurred under the Modeling Condition for 12 of the 14 students. The greatest increase in performance when all three conditions are compared occurred under the Modeling Condition for eleven students. Complete experimental control along with a high degree of control was demonstrated during the Modeling Condition for four students. Experimental control was demonstrated to a lesser degree for five other students.

A greater increase in the mean percentage of accuracy occurred during the Still Illustration Condition when compared to the Motion Illustration Condition for five students. A greater increase in performance when compared to the Modeling Condition occurred for two students. The greatest increase in performance when all three conditions are compared occurred for two students during the Still Illustration Condition. An increasing trend in performance occurred


for nine students. Complete or partial experimental control was demonstrated for the Still Illustration Condition plus the Modeling Condition over the Motion Illustration Condition for four subjects (Subjects 9, 11, 12, 14), however, a differential effect between the Still Illustration and Modeling Conditions was not demonstrated for these students. In no cases was a differential effect of treatment of the Still Illustration Condition demonstrated over the Modeling Condition.

A greater increase in the mean percentage of accuracy for the Motion Illustration Condition over the Still Illustration Condition occurred for eight of the fourteen students. A greater increase in performance when compared to the Modeling Condition occurred for only one student. The greatest increase in performance when all three conditions are compared occurred during the Motion Illustration Condition for only one student. An increasing trend in performance occurred for six students. A differential effect of treatment when compared to the Still Illustration Condition occurred for two students (Subjects 5 and 6). In no other cases was a higher differential effect demonstrated during the Motion Illustration Condition. Experimental control was not demonstrated during any condition for subjects 10 and 13.

Analysis of individual data indicated that most students (79 percent) increased accuracy of letter formations during the Modeling Condition when compared to the Still or Motion Illustration Conditions. Also, complete or partial experimental control was established for
nine students for the Modeling Condition. A differential effect for
the Still Illustration Condition over the Motion Illustration Condition
was observed for four students, but this effect was not demonstrated
over the Modeling Condition. The Motion Illustration Condition
demonstrated a differential effect over the Still Illustration
Condition for two students, but not over the Modeling Condition. No
differential treatment effect was observed for two students.

4. If an increase in the percentage of correct manuscript letter strokes (trained in isolation) under
any antecedent technique occurs, will this change transfer to letters written in context of words
in a sentence?

This question compared an increase in letter formation accuracy
for letters written in isolation during an intervention to letter
formation accuracy when written in context of the sentence "The quick
brown fox jumps over the lazy brown dog." The letters trained in
isolation during each intervention were measured and the mean percent-
age of correct responses were recorded for individuals and the group
to determine if an increase in performance occurred under any inter-
vention (Tables 7 through 10). The letters written in context were
measured and the mean performance of correct responses for individuals
and group were recorded.

Group data during interventions indicated an increase in perfor-
man ce occurred during the Modeling Condition (Figure 1). Mean
performance for the group was 42.3 percent. Data on in context
handwriting for the set of letters trained under the Modeling condition for the group revealed a mean performance score of 42.5 percent. Data indicate that the increase in letter formation accuracy transferred to the letters when written in context of words of a sentence as the difference in mean accuracy in .2 percent in favor of the letters written in context.

Group data during interventions did not indicate an increase in letter formation accuracy for the set of letters trained during the Still or Motion Illustration Conditions, therefore, a transfer check was not administered.

For the thirteen individual students who demonstrated a mean increase in letter accuracy for letters written in isolation during the Modeling Condition, in context data indicated mean performance for twelve of these students was similar (within 7 percent) or greater during transfer and much lesser for one student, indicating successful transfer for 13 of the 14 students.

For the five students who demonstrated a mean increase in performance during the Still Illustration Condition, in context data indicated mean performance for four students was similar or greater and lesser for one, indicating successful transfer for 4 out of 5 students.

For the eight students who demonstrate a mean increase in performance during the Motion Illustration Condition, in context data indicated mean performance for six students was similar or greater and lesser for two, indicating successful transfer for 6 of the 8 students.
Overall, a high percentage of students (82 percent) who demonstrated an increase in letter accuracy for letters written in isolation during an intervention, demonstrated a similar or greater accuracy when letters were written in context of words in a sentence. This may indicate that an increase in (lower-case manuscript) letter formation accuracy for letters written in isolation will transfer to a similar increase when the letters are written in context of words in a sentence. A possible explanation for this occurrence may be the similarity of writing manuscript letters in isolation and in context of words, the only difference being that of spacing between letters while letter formation remains the same.

Limitations

The evaluative instruments used were designed to measure deviations of zero to one millimeters from model lower case manuscript letters. Overlays copied using a 3M Thermofax machine resulted in thick boundary lines and horizontal lines. Overlays duplicated using the Diazo Process (Helwig, et al., 1976) resulted in thin boundary lines and horizontal lines. Use of the thick lined (3M) overlays for scoring allowed for greater flexibility in applying the containment criterion because of the thickness of the boundary lines. At the same time, the thicker lined overlay allowed for a smaller degree of vertical movement when matching lines due to the thickness of writing paper lines and matching horizontal lines on the overlay. In contrast, the thin-lined Diazo overlays allowed for less flexibility in applying the containment criterion due to the thinness of the boundary lines.
However, the thin-lined overlays allowed for greater flexibility of vertical movement due to the thickness of the writing paper lines and the thinness of the Diazo produced horizontal lines used to align the overlay on the copy paper. Thus, letter accuracy scoring may have been effected either negatively or positively depending upon the degree of horizontal or vertical movement allowed by using the 3M thermofax overlays or the Diazo overlays.

Also, the positioning of the four horizontal lines on the overlays used to position the overlays over the sample letters did not match perfectly with the four horizontal lines on the students' paper. Thus, the experimenter chose to match the top horizontal line when scoring samples. This may have skewed letter scores as letters containing upper strokes may have been scored higher than letters containing lower strokes which may have been scored lower. If the experimenter matched the red baselines for scoring purposes instead, this may have limited the skewness as all letters sit on the red baseline. Also, reconstructing the overlays so that all horizontal lines matched perfectly with the lines on the copy paper would have avoided this problem.

Another variable which may have affected the data was subject reactivity to the experimenters. Three unknown adults entering the classroom and implementing the treatment procedures may have had a different effect on student performance than the regular teachers implementing the interventions after training. Also, because the teachers administered the pre-test (Baseline) condition, subject reactivity to the experimenters would have been evidenced only during
the intervention conditions. It may have been more useful to involve
the teachers throughout the entire experiment to check for possible
subject reactivity to the experimenters. Another factor to consider
is that of possible differential subject reactivity to the different
experimenters. Subjects may have performed better or worse for
different experimenters. An attempt to control this was made by
having each experimenter present each treatment at least once through­
out the experiment. However, it may have been more effective to have
the three experimenters present each intervention an equal number of
times throughout the experiment.

Another factor which must be addressed is the order of presenta­
tion of letters during each intervention. During the Modeling and
Still Illustration Conditions, letters were consistently presented to
students in a set order. However, during the Motion Illustration
Condition, letters were presented to students in differing orders
during the six sessions. Students may have become used to a set order
of presentation during two conditions but not the other. For
consistency purposes, a set order of presenting all letters might have
been more appropriate.

A fourth factor of consideration is that of distance of the model
letters from the students. During the Motion Illustration and Modeling
Conditions, model letters were displayed to students on a screen or
board approximately four to six feet from the students. During the
Still Illustration Condition, a copy of model letters was placed
directly in front of students on their table for copying purposes.
This may have resulted in better visual discrimination of letters in
the Still Illustration Condition, possibly increasing accuracy of copying. Displaying all letters at an equal distance would have eliminated this variable. This could have been accomplished by displaying the Still Model Letters at an equal distance from the students using the large letter wall chart contained in the Zaner Bloser Creative Growth Manuscript Alphabet Teacher Guide-Pak #1 (1974). Also, during the Still Illustration Condition, the entire set of nine letters on a model sheet were given to the student for copying purposes. During the other conditions, one letter at a time was presented for copying. Having all nine letters on one sheet may have been more distracting to the students when copying from the Still Model. By presenting one letter at a time during the Still Illustration Condition, this factor would be eliminated.

During in context handwriting, the shape, color, and thickness of the copying paper was different than the paper used during interventions. During interventions, Zaner Bloser Writing Paper Number 1, a thin, bone-white paper measuring eight inches vertically and ten and one-half inches horizontally was used. The paper used during in context handwriting was a thicker, white paper measuring eleven inches vertically and eight and one-half inches horizontally. In context letter accuracy might have been increased if the same copy paper was used throughout the entire experiment.

A final limitation of this study is that because of the small sample size and selection procedures, no statement can be made regarding the generalization of the results of this study to other
groups of students. However, previous studies indicate the modeling combined with simple verbal directions is an effective procedure for increasing performance on a variety of behaviors including handwriting (Hayes, 1982; Sovik, 1976). Replications of this study, in all or in part, will help determine the extent to which results are generalizable to other student populations and settings.

**Implications**

The use of modeling combined with simple verbal directions has been demonstrated as an effective antecedent technique for improving student performance on reproducing lower-case manuscript letter formations for a group of kindergarten students. Providing students with a visual and verbal demonstration of letter formations is a productive strategy in introducing manuscript letters for teachers. The procedure is easily implemented requiring a short amount of time and the materials needed are available in most classrooms. It has been further demonstrated that modeling combined with simple verbal directions is a more effective technique in promoting letter formation accuracy of kindergarten students than copying from a still model of letters or a model depicting letter stroke movement through motion.

Since a small percentage of students increased their letter accuracy when copying from a still model or a motion model, a further implication of the study would be for teachers to assess which technique is more effective for individual students and employ it as a further means of individualizing handwriting instruction. This can be done, as was demonstrated in this study, in a relatively short period of time (less than four weeks) and the use of the evaluative
overlays as an objective measurement instrument which teachers and students can easily and reliably use has been demonstrated in a previous study by Johns (1976).

The study further demonstrates that an increase in manuscript letter formation accuracy for letters trained in isolation using still illustrations, motion illustrations, or modeling as an instructional technique will result in a similar level of accuracy when the letters are written in context of words in a sentence for a high percentage of students.

Most kindergarten teachers are faced with the task of introducing manuscript handwriting to their students. Several researchers have stated that copying is the preferred method of instruction by most teachers. The use of teacher modeling of letter formations combined with simple verbal directions has been demonstrated as an effective antecedent technique in promoting copying behavior of kindergarten students.

Recommendations for Further Research

A series of studies could be developed from results of the present study. Such studies could include:

1. A replication of this study using pre-school students (age 3-5) to determine if any of the techniques used would be effective in promoting general copying behavior.
2. A replication of this study using first and second grade students to determine if age and/or grade level of the students produces different results than with the kindergarten population.

3. A study examining the effects of modeling, still illustrations, and motion illustrations on aiding the transition from manuscript style to cursive style of handwriting can be developed.

4. A future study could examine the effects of peer modeling on letter formation accuracy of students.

5. Another study could explore whether kindergarten students could be taught to reliably use the plastic overlays to evaluate their manuscript handwriting.

6. A final study could examine the effects of packaged treatments involving the use of still models, motion models, and teacher modeling on increasing accuracy of letter formations. Would, for example, student performance increase greater following a packaged treatment involving teacher demonstration, verbal instructions, plus the use of a still model?

More recommendations for further studies will grow out of any additional studies. The studies will furnish empirical data on the use of antecedent techniques to improve handwriting with different age or grade level students, the effect of peer modeling, and effective procedures for improving handwriting legibility.
Summary

Handwriting is an important communication skill taught to all children receiving a formal education. It is a means of individualized expression whose relationship to the development of the other language arts has been demonstrated by some extent by research. To be easily read and interpreted by the person or persons for whom it was written, handwriting must be legible. Correctness of letter formation is regarded by teachers and researchers as the single most important element of legibility (Wright & Allen, 1975).

In teaching handwriting legibility to students, copying seems to be the most preferred method of instruction by teachers. A review of research supports the contention that copying is the most effective instructional technique in teaching legibility. Few studies have examined the use of antecedent techniques in handwriting instruction to promote student letter copying accuracy.

This study examined the differential effects of three antecedent techniques on letter formation accuracy. The techniques examined were copying from a still model of letters (Still Illustration), copying from a model depicting letter formation through movement (Motion Illustration), and copying letters after a live demonstration of letter formation combined with simple verbal directions (Modeling).

The first two questions of this study tried to determine which technique would result in an increase in the percentage of correct manuscript letter strokes of kindergarten students and which technique would produce the greatest increase. The third question of this study
attempted to determine if a functional relationship (experimental control) could be demonstrated between student performance and an antecedent technique. The final question attempted to determine whether increased accuracy of letters written in isolation during an intervention would transfer to a similar level of accuracy when letters were written in context of words in a sentence.

To answer the above questions, handwriting samples on lowercase manuscript letters were obtained from fourteen kindergarten students during 27 sessions. All student handwriting samples were measured by using evaluative overlays designed to measure deviations of one millimeter from model letters. Scores were reported as percentage of correct letter strokes made by each student and mean percentage of letter accuracy for the total group during each condition.

The following controls were employed in this study: All of the sessions were totally conducted in the students' classroom to control for a novel effect of a different setting, pre-test measurements of letter accuracy for the three sets of letters assigned to the three interventions were made to insure similar performance for each set of letters prior to interventions, rotation of experimenters during administration of treatments to control for subject reactivity to one experimenter, random alternation of treatments throughout the experiment to control for sequence and contrast effects, administration of each treatment by each experimenter at least once during the study to prevent differential subject reactivity occurring for one treatment, control procedures for differential experimenter treatment during the
administration of treatments which include an audiotape cassette recording of one presentation for each condition by each experimenter with the data scored by two evaluators for accuracy and consistency of presentation, and interobserver agreement checks for total strokes, correct strokes, and incorrect strokes for student samples during each intervention and in context handwriting.

Analysis of the audiotaped presentations failed to show any differences in the administration of treatments between the three experimenters as accuracy and consistency scores for presentations were 100 percent. Interobserver agreement on the taped presentations for the two evaluators scoring the tapes was 100 percent. Interobserver agreement measures on all strokes during the three treatments ranged from 71 percent to 100 percent with a mean of 95.7 percent. Agreement on correct strokes for the interventions ranged from 50 to 100 percent with a mean of 92.7 percent. Agreement on incorrect strokes ranged from 82 to 100 percent with a mean of 97.3 percent. Interobserver agreement on all strokes for letters written in context ranged from 82 to 100 percent with a mean of 94.1 percent. Agreement on correct strokes ranged from 0 to 100 percent with a mean of 87.8 percent. Agreement on incorrect strokes ranged from 83 to 100 percent with a mean of 96.7 percent.

To determine whether letter accuracy for the three sets of letters used during the interventions were similar for the group prior to interventions, pre-test measures in the form of baseline data were administered. Data were collected on the accuracy of three sets of letters during baseline for six sessions. Data were scored as
percentage of correct letter strokes for each set of letters for individual students and the group. The mean percent of letter accuracy for the three sets of letters for the group differed by only 2.3 percent. The greatest difference in sets for eleven of the fourteen students was six percent or less, while three students had a difference of seven percent. Pre-test measurements indicated letter accuracy for the three sets of letters was similar prior to interventions.

A multielement design was used to evaluate the differential effects of the three interventions on lower-case manuscript letter formation accuracy. This design involves the repeated measurement of a behavior under alternating conditions of the independent variable (Ulman & Sulzer-Azaroff, 1976). The three conditions administered were Still Illustration, Motion Illustration, and Modeling. During the Still Illustration Condition, the experimenter gave each student a still model of letters containing arrows and numbers which indicated the direction of letter stroke formation which the students copied from. During the Motion Illustration Condition, the experimenter displayed letters on a screen using an overhead projector with a specially designed adapter which caused the strokes in each letter to continually move in the direction of letter formation. Students observed the movement in the model letter and copied it. During the Modeling Condition, the experimenter demonstrated the formation of a letter by writing it on a board while providing simple verbal directions concerning letter stroke formations. The students observed, then copied the letter.
Upon termination of the Still Illustration, Motion Illustration, and Modeling Conditions, data on each set of letters were collected for three sessions when letters were written in context of words in a sentence. The purpose of this data was to determine whether increased accuracy of letters written in isolation during an intervention would transfer to a similar level of accuracy when letters were written in context of the sentence "The quick fox jumps over the lazy brown dog."

The Modeling Condition produced an increase in letter accuracy for the group with a mean score of 42.3 percent accuracy. Complete experimental control (functional relationship) was demonstrated throughout the entire eighteen sessions of interventions. A regression line analysis indicated a large, positive acceleration (slope 1.02) for the Modeling procedure across sessions. A mean increase in letters for the group during the Still and Motion Illustration Conditions did not occur. In fact, group means for both conditions were lower than during baseline. Experimental control was not demonstrated under either condition. Regression line analyses indicate a moderate positive acceleration (slope .44) for the Still Illustration Condition across sessions and a slightly negative deceleration (-.28) for the Motion Illustration Condition across sessions.

Results of individual data closely resemble those of the group as most students (79 percent) demonstrated the greatest increase in letter accuracy during the Modeling Condition. Complete or partial experimental control was established for nine of the fourteen students. The majority of regression lines (12 out of 14) were positive.
The greatest increase in performance during the Still Illustration Condition occurred for two students (14 percent), who also demonstrated partial experimental control. Nine students had increasing regression lines.

The greatest increase in performance and a demonstration of partial experimental control during the Motion Illustration Condition was demonstrated by only one student. Increasing regression lines were demonstrated by six students, while eight others demonstrated decreasing trend lines.

During in context handwriting, overall, for the students who demonstrated an increase in accuracy for a set of letters written in isolation during an intervention, a high percentage (82 percent) also demonstrated similar accuracy when letters were written in context of words in a sentence. Twelve of the thirteen students who demonstrated an increase in letter accuracy for the set of letters written in isolation during the Modeling Condition demonstrated a similar or greater increase in accuracy during in context handwriting.

Four of the five students who demonstrated an increase in letter accuracy for the set of letters written in isolation during the Still Illustration Condition demonstrated a similar or greater increase in accuracy when written in context. Six of the eight students who demonstrated an increase in letter accuracy for the set of letters written in isolation during the Motion Illustration Condition demonstrated a similar or greater increase in accuracy during in context handwriting.
It can be concluded that (a) the use of Modeling combined with simple verbal directions produced the greatest increase in manuscript letter formation accuracy for the greatest number of kindergarten students. (b) The use of Still Illustrations in the form of copying from a still model of letters produced the greatest increase in manuscript letter formation accuracy for a much lesser number of kindergarten students. (c) The use of Motion Illustrations in the form of moving letter strokes displayed on a screen produced the greatest increase in manuscript letter formation accuracy for the smallest number of kindergarten students. (d) An increase in accuracy of lower-case manuscript letter formations trained in isolation under any of the above interventions will transfer to a similar level of accuracy when letters are written in context of words in a sentence for a high percentage of students. (e) The greatest transfer will occur for students trained under the Modeling plus verbal directions condition.
APPENDIX A

Baseline Model Letters (Reduced)
APPENDIX B

Recording Forms (Reduced)
|     | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u |
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**Condition Summary**

- **Mean:**
- **Range:**
- **Trend:**
**Name:**

**Still Condition**

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**Condition Summary**

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Modeling Condition

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Condition Summary
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Range: ____________________________

Trend: ____________________________
APPENDIX C

Parent Cover Letter and Consent Form (Reduced)
December 15, 1981

Dear Parent:

Handwriting is an important skill taught to all children receiving an education. It is a method of communication and expressing thought. It is a means by which children can efficiently express their thoughts and ideas to teachers and others.

Formal handwriting instruction is usually introduced to children around the age of five or six in Kindergarten or First grade. Initially, manuscript letter formations are taught. In most cases, two instructional models are used by teachers when teaching handwriting. Live modeling, in which the teacher writes a letter on the blackboard and asks the student to copy it, and still modeling, in which the teacher gives the student a sheet of letters and asks the student to copy them are the two models used frequently. But, which model works better? Might there be another instructional model, besides these, which works well in teaching handwriting?

I will be attempting to answer these questions during a research project I will be conducting, along with Dr. John Cooper and Dr. Jennifer Porter, at the Alternative Children's Center. We will be examining the effects of using the two instructional models mentioned above, plus a third model, a photo-motion model, in which letters are placed on an overhead projector which demonstrates how to form each letter. This research project is designed to determine which model is most effective in teaching manuscript letter formations.

We are requesting your permission to let your child participate in this study. The investigators will use each of the three models when instructing manuscript letter formation and will then compare the effects of each model on student handwriting. By evaluating the handwriting samples of the students, the information obtained by this study can benefit your child tremendously as it will help teachers realize the most effective means of teaching your child how to write. Your child will have a head start on his/her manuscript handwriting. Results of the study will be confidential.

If you are willing to let your child participate in this research, please sign the attached consent form and return it to your child's teacher as soon as possible. If you would like any further information on this study, you can contact Louis LaNunziata at 422-2227 or 457-9632, and I will be happy to answer any questions you may have. I hope you will allow your child to participate in this valuable research project. Thank you for your cooperation.

Sincerely,

Louis LaNunziata
Ph.D. Candidate
The Ohio State University

OSU

The Ohio State University

Academic Faculty
for Exceptional Children
366 Arps Hall
1945 North High Street
Columbus, Ohio 43210
Phone 814 422-6727
I consent to ________________ (Child's name) participating in a study entitled The Differential Effects of Live, Still, and Photo-Motion Models on Manuscript Legibility. The nature and general purpose of this handwriting research has been explained to me in a cover letter accompanying this form. This research is to be performed under the direction of Louis J. LeNunziata, who is authorized to use the services of others in the performance of the research. I understand that the program is optional and that there are no risks involved for my child.

STATEMENT OF CONFIDENTIALITY: I understand that the confidentiality of my response will be observed in a manner consistent with the goals of the project and my individual right to privacy.

Finally, I acknowledge that I have read and fully understand the cover letter and consent form. I understand that any further questions I may have concerning the research described will be fully answered. I understand that I am free to withdraw my consent and stop participation in the project at any time. I have signed the consent form freely and voluntarily and understand a copy is available upon request.

Date: ________________ Signed: ____________________________ (Parent or Guardian)

(Investigator/Project Director or Authorized Representative)

Louis J. LeNunziata

Dr. John O. Cooper

Dr. Jennifer Trap Porter

THE OHIO STATE UNIVERSITY

CONSENT FOR PARTICIPATION IN
SOCIAL AND BEHAVIORAL RESEARCH

College of Education Faculty for Exceptional Children 950 Alva Mall 1905 North High Street Columbus, Ohio 43210 Phone 614-688-2701
APPENDIX D

Still Illustration Letters (Reduced)
APPENDIX E

Copy Paper (Reduced)
APPENDIX F

Evaluative Overlay: (1 M.M.) (Reduced)
APPENDIX G

Motion Illustration Overlay (Reduced)
APPENDIX H

In Context Handwriting Model Sheet (Reduced)
The quick fox jumps over the lazy brown dog.
APPENDIX I

Checklists of Presentation Components (Reduced)
### MOTION CONDITION COMPONENTS

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Verbal statement designed to make students feel at ease.</td>
</tr>
<tr>
<td>2.</td>
<td>Students are asked to put pencils down and watch or listen.</td>
</tr>
<tr>
<td>3.</td>
<td>Instructor explains that the overhead projector will show a letter with moving strokes and will demonstrate how the students should follow the moving strokes to form the letter.</td>
</tr>
<tr>
<td>4.</td>
<td>Students are asked to copy a letter as it appears on the overhead display.</td>
</tr>
<tr>
<td>5.</td>
<td>Instructor asks if each student has finished and repeats procedure.</td>
</tr>
<tr>
<td>6.</td>
<td>Instructor thanks students for working.</td>
</tr>
<tr>
<td>7.</td>
<td>At no time is any reinforcement, editorial or evaluative information regarding the quality of work offered to the students.</td>
</tr>
</tbody>
</table>

### MODELING CONDITION COMPONENTS

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Verbal statement designed to make students feel at ease.</td>
</tr>
<tr>
<td>2.</td>
<td>Students are asked to put pencils down and watch or listen.</td>
</tr>
<tr>
<td>3.</td>
<td>Instructor asks students to watch and listen as he/she writes letter on board while providing simple directions on letter formation.</td>
</tr>
<tr>
<td>4.</td>
<td>Students are asked to copy the letter on their paper.</td>
</tr>
<tr>
<td>5.</td>
<td>Instructor asks if students have finished and repeats procedure.</td>
</tr>
<tr>
<td>6.</td>
<td>Instructor thanks students for working.</td>
</tr>
<tr>
<td>7.</td>
<td>At no time is any reinforcement, editorial or evaluative information regarding the quality of work offered to the students.</td>
</tr>
</tbody>
</table>
STILL CONDITION COMPONENTS

1. ___ Verbal statement designed to make students feel at ease.

2. ___ Students are asked to put pencils down and watch or listen.

3. ___ Using an upper case letter, the instructor demonstrates how students should follow the numbers and arrows on the letter when they write the letter on their paper.

4. ___ Students are then asked to copy their letters on their paper following the numbers and arrows.

5. ___ Instructor asks if each student has copied all letters.

6. ___ Instructor thanks students for working.

7. ___ At no time is any reinforcement, editorial or evaluative information regarding the quality of work offered to the students.
APPENDIX J

Selected Student Samples (Reduced)
* Brenabah

Y X UP omcil
* Bhutan

OIRG srWFL
Hol. X
b.Cmo Pux

Date - 10/0
Condition - Motion
C 0.000002 - 3
Dear KLV

Holly

1/21/00
Nathgh
af 1
h 5 etwz

Oct 21/32
Condition: still
cond: severe-3
TS

\[ U = 1 \]

Date: 2/18/22
Condition: Line Modeling
Casual: A-1


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