SEGMENTATION AND ANALYSIS OF PHONEMIC UNITS AS
RELATED TO ACQUISITION OF THE INITIAL
CONSONANT PHONEME-GRAPHEME
CORRESPONDENCE

DISSERTATION

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

Barbara A. Mathews, B.S., M.S.
Denton, Texas
March, 1981
Mathews, Barbara A., *Segmentation and Analysis of Phonemic Units as Related to Acquisition of the Initial Consonant Phoneme-Grapheme Correspondence*. Doctor of Philosophy (Reading), March, 1981, 96 pp., 12 tables, bibliography, 34 titles.

The ability of students to segment the speech stream into phonemic units and to analyze (make judgments as to same or different) beginning consonant phonemes was assessed at grades kindergarten through third from both high and low socioeconomic groups.

Segmentation ability was assessed by the use of a test of actual words in a match-to-sample task, a test of synthetic words requiring a same-different judgment and a task which required deletion of a phoneme from a known word to form a new word. Three prerequisite abilities were also assessed: auditory acuity and understanding of the concepts "same" and "different" with regard to sounds, and "beginning" with regard to sequence of sounds.

Findings indicate:

1. Approximately 30% of students from low-socioeconomic groups do not possess this ability during the years of beginning reading acquisition.

2. The ability appears to be a mastery learning task.

3. Lack of the ability appears to result in paired
associative learning when the phoneme-grapheme correspondence is taught.

4. The most appropriate test of the ability for younger children requires a test of actual words while the test of older students must utilize a test of synthetic words.

5. The ability to segment speech into phonemic units is more highly correlated with achievement in reading as the demands of decoding are increased.

The implications of this study are:

1. The prerequisite concepts must be assessed and taught if necessary before the ability to segment speech is assessed or before instruction in the phoneme-grapheme correspondence is initiated.

2. It is necessary to assess the students ability to segment the speech stream into phonemic units and make analysis before instruction in the phoneme-grapheme correspondence can be initiated.

3. Placement of the phoneme-grapheme correspondence instruction in the curriculum should be different for groups with different ability.

4. Students who are unable to perform the segmentation task should be instructed by (a) an approach to beginning reading that minimizes the importance of the sound-symbol correspondence and emphasizes visual learning, (b) a method which helps these students acquire the ability, or (c) both.
5. A formative evaluation of student learning should be conducted as the phoneme-grapheme correspondence is taught so that if paired-associational learning rather than concept learning occurs, it is detected.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>LIST OF TABLES</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>v</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LIST OF ILLUSTRATIONS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>vi</td>
</tr>
</tbody>
</table>

## Chapter

### I. BACKGROUND AND SIGNIFICANCE OF THE STUDY

- Introduction
- Statement of the Problem
- Specific Purposes of the Study
- Significance of the Study
- Hypothesis
- Definition

### II. SYNTHESIS OF RELATED LITERATURE

- Introduction
- Phoneme-Grapheme Correspondence Learning
- Barrier to the Acquisition
- Analogy to the Development of Writing Systems
- Other Research Studies Concerning with the Difficulty of Segmentation
- Development of Programs

### III. PROCEDURES OF THE STUDY

- Research Design
- The Population
- Selection of the Sample
- The Subjects
- Teacher Influence
- The Instrument

### IV. RESULTS, DISCUSSION, AND CONCLUSIONS

- Results
- Discussion
- Conclusions
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>V. IMPLICATIONS, RECOMMENDATIONS,</td>
<td>79</td>
</tr>
<tr>
<td>LIMITATION, AND SUMMARY</td>
<td></td>
</tr>
<tr>
<td>Implications</td>
<td></td>
</tr>
<tr>
<td>Recommendations</td>
<td></td>
</tr>
<tr>
<td>Limitation</td>
<td></td>
</tr>
<tr>
<td>Summary</td>
<td></td>
</tr>
<tr>
<td>APPENDICES</td>
<td>88</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>94</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sample Groups</td>
<td>23</td>
</tr>
<tr>
<td>2.</td>
<td>Subjects Dropped Because of Lack of Permission Letter</td>
<td>25</td>
</tr>
<tr>
<td>3.</td>
<td>Subjects Dropped Because of Lunch Classification</td>
<td>26</td>
</tr>
<tr>
<td>4.</td>
<td>Subjects Dropped Because of Non-English Speaking Background</td>
<td>27</td>
</tr>
<tr>
<td>5.</td>
<td>Summary of Disqualified Subjects</td>
<td>28</td>
</tr>
<tr>
<td>6.</td>
<td>Correlation Coefficients for Reliability of Test Components</td>
<td>38</td>
</tr>
<tr>
<td>7.</td>
<td>Comparison of Mean Scores of Groups Tested by Each Examiner</td>
<td>44</td>
</tr>
<tr>
<td>8.</td>
<td>Probabilities Associated with the Chi Square Approximation of the Kruskal Wallis Test</td>
<td>48</td>
</tr>
<tr>
<td>9.</td>
<td>Mean Scores and Standard Deviations of Test Components by Socioeconomic Status and Grade Level</td>
<td>50</td>
</tr>
<tr>
<td>10.</td>
<td>Per Cent of Students Achieving Mastery on Each Component by Grade Level and SES</td>
<td>55</td>
</tr>
<tr>
<td>11.</td>
<td>Mean Scores of the Socioeconomic Groups on Components D, E, and F and Per Cents of Mastery</td>
<td>65</td>
</tr>
<tr>
<td>12.</td>
<td>Ability Measured by Test Components</td>
<td>66</td>
</tr>
</tbody>
</table>
## LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mean Scores for Each Grade Level by SES Group on Components D, E, and F</td>
<td>53</td>
</tr>
<tr>
<td>2.</td>
<td>Percentage Scoring Mastery at Each Grade Level by SES Group on Components D, E, and F</td>
<td>56</td>
</tr>
<tr>
<td>3.</td>
<td>Percentage Scoring Mastery on Test Deemed Best Measure of the Ability at Each Grade Level by SES Group</td>
<td>68</td>
</tr>
<tr>
<td>4.</td>
<td>Frequency Distributions of Scores of the Kindergarten Groups on Component E</td>
<td>71</td>
</tr>
<tr>
<td>5.</td>
<td>Frequency Distributions of Scores of First-Grade Groups on Component E</td>
<td>71</td>
</tr>
<tr>
<td>6.</td>
<td>Frequency Distributions of Scores of Second-Grade Groups on Component D</td>
<td>72</td>
</tr>
<tr>
<td>7.</td>
<td>Frequency Distributions of Scores of Third-Grade Groups on Component D</td>
<td>73</td>
</tr>
</tbody>
</table>
CHAPTER I

BACKGROUND AND SIGNIFICANCE OF THE STUDY

Introduction

One of the first skills a beginning reader is taught is the phoneme-grapheme correspondence. Regardless of which approach to beginning reading is used, the child is usually taught the names of all of the letters of the alphabet and the initial consonant phoneme-grapheme relationship before he is taught to decipher text (Auckerman, 1971).

Although learning the phoneme-grapheme relationship seems to be an easy task for many children, a significant number of children experience considerable difficulty with this acquisition. A pilot study, conducted in 1979-80 by the author, indicated that 25% of first graders in a low-socioeconomic setting were unable to identify phonemes.

A small body of research, contributed by several psychologists (Savin, 1972; Liberman, Cooper, Shankweiler, Fisher & Carter, 1974; Gleitman & Rozin, 1973), has indicated that the barrier to the acquisition of alphabetic units may be a psychoacoustic problem rather than a problem of auditory discrimination as was previously thought. Because consonant phonemes are folded into the vowel at the acoustic
level, there is no acoustic criterion by which the child can easily segment the sound into phonemes.

There is some evidence to indicate that age and socioeconomic background influence this ability. Although the extent of the influence is not yet established, the literature suggests that the task is developmental and that children from low-socioeconomic backgrounds experience more difficulty.

**Statement of the Problem**

The problem of this study was to identify the beginning reader's ability to segment (at the psychological level) speech sounds into phonemic units.

**Specific Purposes of the Study**

Specifically, the purposes of this study were

1. to ascertain if a difference existed between social class and the ability to segment (at the psychological level) the speech stream into phonemic units at the primary grade levels;

2. to determine if a developmental-like trend existed in each of the socioeconomic status groups so that the per cent of mastery was greater at each successive grade level;

3. to determine if ability to perform the segmentation task was significantly correlated with achievement in reading; and
4. to determine what proportion of subjects were able to demonstrate the ability to segment (at the psychological level) the acoustic stream into phonemic units at each grade level.

**Significance of the Study**

Forming a positive attitude about reading, having good feelings about the ability to learn, as well as acquiring basic skills are dependent upon successful experiences in the beginning reading process. Because acquisition of the phoneme-grapheme correspondence is usually the first association a child has with formal reading instruction, his or her experiences in this learning are especially important.

Although we know that this first learning period is very important, little research has concentrated on this area. Gibson (1970) states, "We should know a great deal about how the writing-speech code is learned but we do not; we only know that it is more than paired-association" (p. 139). A pilot study done by the author in 1979-80 indicated that the first-grade children who were unable to segment the acoustic stream and were instructed by traditional methods, did, in fact, adopt the inappropriate strategy of paired-associative learning.

Gibson and Levin (1975) have warned, "If the child has not abstracted the set of features which, in various combinations, make up the phonemes of his language, then the
strategy for teaching him the correspondences between letters and the phonemes they represent will be impossible" (p. 119). They further state, "The child must develop the ability to hear segmentation in what is spoken to him before we can reasonably expect him to learn to map the written code to speech or vice versa" (p. 325).

However, in this first important learning, teachers often do "assumptive teaching." It is assumed that a child already perceives speech as a sequence of phonemes and that the task quite simply involves learning which letters of the alphabet correspond with which phonemes (Savin, 1972).

Savin further suggests,

The hypothesis that time invariably brings about a cure ought to be explored. There is no point in subjecting large numbers of first grade teachers and students to great frustration if the unsuccessful pupils would easily learn in a year or two. The harm done to student motivation and morale by prolonged instruction that he is not yet ready to understand must be immense and in many cases, long lasting (p. 325).

Thus, it seems imperative that we understand this learning task better, that we investigate the variables associated with difficulty such as age and socioeconomic status, and that we determine how problems affect achievement in reading. This knowledge should enable us to better tailor our curriculum to the developmental level of the child. One might reasonably expect achievement as well as motivation and morale to be positively affected by prescriptive rather
than assumptive instruction in this first task of beginning reading.

**Hypotheses**

The following hypotheses were formulated for this study:

1. A significant difference in the ability to segment (at the psychological level) speech sound into phonemic units will exist between the two socioeconomic classes at each grade level.

2. A developmental-like trend will be observed in each of the socioeconomic classes so that the mean of the kindergarten group < the mean of the first-grade group < the mean of the second-grade group < the mean of the third-grade group.

3. A statistically significant correlation will exist between the ability to segment the speech stream into phonemic units and achievement in reading.

**Definition of Terms**

For the purpose of this study, the following definitions of terms were adopted. The terms grapheme, phoneme, psycho-acoustic level, segmentation, and analysis, which are well known in the field of linguistics, and bear very specific meanings to a linguist, are here given meanings which are somewhat different from those encountered in strictly
linguistic studies. Here they are used in specialized senses which are appropriate in the area of reading.

Developmental-like trend refers to a difference in the ability of subjects to perform the task of segmentation and analysis so that the ability is greater at each successive grade level.

Grapheme refers to the graphic representation of the phoneme.

Phoneme refers to the smallest segment of spoken word; a meaningless unit of sound which corresponds to a grapheme or graphemes.

Psychoacoustic level refers to the mental level at which the segmentation of consonant sounds from vowel sounds occurs.

Segmentation and analysis refers to the ability to (a) segment (at the psychoacoustic level) the beginning consonant from the vowel which follows it and (b) make a judgment as to whether words begin with the same sound or begin with different sounds.
CHAPTER II

SYNTHESIS OF RELATED LITERATURE

Introduction

The acquisition of the phoneme-grapheme correspondence is considered to be an essential first task for the beginning reader of an alphabetic language. Savin (1972) maintains that it would be inefficient to the point of absurdity to teach all of the tens of thousands of words a person has in his active vocabulary as though each were an arbitrarily chosen hieroglyph and there were no underlying principle relating the spelling of a word to its sound.

Although reading was taught by a sight-word approach (utilizing associational learning) for a number of years, evidence accumulated during the period of the '60s (Bliesmer & Yarborough, 1965; Bond & Dykstra, 1967; Chall, 1963; Austin & Morrison, 1963) prompted reading authorities to conclude that the inclusion of phonic principles in a beginning reading program is a necessity.

Although phonic skill is necessary, reading is not simply a matter of decoding graphemes one by one. The mature reader utilizes a number of different strategies
in the decoding process: context, configuration, abstracted spelling patterns, and, in a very few cases, phoneme-by-phoneme analysis. Decoding is viewed by Gibson and Levin (1975), Samuels (1973), and others to be a process of finding the invariants (patterns and order) and inducing rules (concept learning) for use with subsequent print that one may encounter. Thus, learning the relationship of the written code to the acoustic code is the imperative first step in the decoding process.

This review of the literature will present,
1. a traditional view of the acquisition of the phoneme-grapheme correspondence;
2. recent work which indicates a possible barrier to the acquisition;
3. an analogy of the acquisition to the development of writing systems;
4. other research studies concerning the difficulty of segmenting speech sounds into phonemic units; and
5. programs which have attempted to deal with the difficulty of segmentation.

**Phoneme-Grapheme Correspondence Learning**

The acquisition of the phoneme-grapheme correspondence has traditionally been thought to include three general kinds of skills: (a) visual discrimination of the graphemes, (b) auditory discrimination of speech sounds, and
(c) intersensory integration (Samuels, 1973; Lapp & Flood, 1978; Gibson & Levin, 1975).

Gibson (1970) in her definitive work on the learning of graphemes has concluded that letters are distinguished from one another on the basis of distinctive features that are shared to greater or lesser degrees by different pairs of letters, but that yield a unique pattern for every member of the set. The ability to discern distinctive features develops during the period of beginning reading (ages 5 to 8). Although it is a very complicated process, most children are able to successfully discriminate these features because of instruction or maturation, or both.

Although auditory discrimination is considered an integral part of the acquisition of the phoneme-grapheme correspondence, most of the work done by reading authorities has been concerned with auditory discrimination as it correlates with measures of reading disability after a child is actually reading words. The results of these kinds of studies have been contradictory. Durrell and Murphy (1953) found that the skill that the disabled reader is most deficient in is auditory discrimination, specifically the ability to segment spoken words into separate sounds that correspond to the sequence of letters or letter groups. Conversely, Dykstra (1966) found relatively low correlation between auditory discrimination and reading achievement at the end of first grade. Samuels (1973), in reviewing the literature
on the subject, stated that much of the difference in the findings can be accounted for by the various ways in which auditory discrimination has been measured.

Intersensory integration is the component of the task which requires the integration of the visual sensory information with the auditory sensory information. Research done by Birch and Belmont (1965) has identified four kinds of integrations. Auditory and visual discriminations are integrations within a sense modality and include, (a) auditory discriminations requiring the ordering and relating of sound patterns organized on a temporal basis and (b) visual discrimination requiring pattern organization on a spatial basis. Integrations between the auditory and visual are, (c) relating auditory patterns in speech which are temporally ordered to the spatially ordered visual patterns, and (d) to actually read, reversing the pattern. Intersensory integration is considered by Richek (1977) to be representative of the G factor of intelligence and to be of considerable importance in reading success.

**Barrier to the Acquisition**

In contrast to traditional thinking, recent work by psychologists interested in verbal learning has indicated that a barrier to the acquisition of alphabetic units may be a purely psychoacoustic problem rather than one of auditory discrimination. Difficulty in the acquisition experienced
by some children appears to involve an inability to segment the acoustic stream into phonemes for the purpose of analysis. Children come to the beginning reading situation competent in the ability to discriminate words differing in only one phoneme. However, because a child can distinguish bat from rat in both his own speech production and his behavioral responses to others' speech, does not mean that he can respond analytically to the phoneme structure that underlies the distinction. It does not mean that he has an understanding that the utterances consist of three segments and that the difference lies wholly in the first. There are not three acoustic segments for bat, each represented by a phoneme. The consonants are folded into the vowel not as graphemes are joined in cursive writing, but encoded at a psychological level into larger units. Thus, there is no acoustic criterion by which a child can easily segment sound units into phonemes (Savin, 1972).

Results of research work done at the Haskins Laboratory, directed by Liberman (1967), help to understand the difficulty. The intent was to determine if there was a small segment of sound that corresponded to each grapheme of a word. Liberman recorded the syllable /di/ on magnetic tape and replayed it over and over again, cutting off a small portion of the tape each time. As the tape was gradually cut, the /i/ sound appeared to grow shorter. When enough of the tape was removed so that the listener no longer heard
the syllable /di/, it was expected that a pure /d/ sound would remain. The resulting sound, however, turned out to be a chirping noise which had no resemblance to normal speech sound. In addition, when they began with the syllable /du/, the remaining sound was a chirp of a different pitch. It was concluded that beginning consonants could not be physically isolated from vowel sounds.

Although this task cannot be physically accomplished, it is obvious that it is possible to recover phonemes from the sound into which they are so complexly encoded. According to Liberman et al. (1974), a special decoder exists in the brain which can segment the continuous acoustic signal according to linguistic rules. They state that, while we can only guess at how it might work, we know that it functions quite automatically for all speaker-hearers of a language, even very young children. Gleitman and Rozin (1973) stated that there is circuitry in the brain to handle the fundamentals and complexities of language that functions without our awareness just as many complex adjustments are made in the nervous system to control blood distribution to different parts of the body. It is when we need the "decoder" for the purpose of analysis outside the context of ongoing speech that at least some aspect of the sound system is inaccessible to reflection.

Savin and Bevers (1970) found that dealing with the phoneme structure was a difficult task for adults, while
segmentation of syllables appeared more natural. They asked adult subjects to listen to tapes on which had been recorded segments of monosyllabic nonsense words. One group was required to identify words that began with a target phoneme while another group was required to identify syllables that contained the first group's target phoneme. Adults were able to identify the phoneme, but, in each case, it took longer than the identification of syllables. Savin and Bevers concluded "that phonemes are primarily neither perceptual nor articulatory entities. Rather, they are psychological entities of a nonsensory, nonmotor kind ... In short, phonemes are abstract" (p. 301).

**Analogy to the Development of Writing Systems**

In looking at the historical development of writing systems, one finds that meaningful units were the first representations. The word was the most typically represented. Writing with meaningless units was a more recent development. The earliest examples of the meaningless units were orthographies using the syllable. The alphabet, representing segments of phonemic size, was developed later out of a syllabary and, unlike the pictorial representation of the word and the syllabic representations, only occurred once (Gelb, 1963; Liberman et al., 1974).

Gibson and Levin (1975) point out that the evolution of the writing system appears to be analogous to the acquisition by the child of the ability to distinguish words, then
syllables, and finally phonemes. Savin, in 1972, found that children in kindergarten, first, and second grades have difficulty in analyzing syllables into phonemes. He maintained that the syllable is a far more natural, more easily available perceptual unit than is the phoneme and suggested, on the basis of a small informal study, instruction of beginning readers in the most frequently used syllables.

Liberman's (et al., 1974) findings also support the analogy to the development of the written code. Middle-class prekindergarten, kindergarten, and first-grade children were examined in order to assess the ability to segment on the basis of phonemes and syllables. The findings indicated that none of the prekindergarten children were able to segment phonemes, whereas 46% were able to do so with syllables. Of the kindergarten children, 17% were able to segment phonemes, whereas 45% were able to segment syllables. Finally, 70% of the first graders were able to segment by phonemes while 90% were able to work with syllables. Their findings suggested that a greater level of intellectual maturity was necessary to analyze words into phonemes than to analyze words into syllables. They conclude, "It may be that the analysis of language even of the most elementary sort requires instruction" (p. 210). They also posit that the orthography of English seems to place a special burden of speech segmentation and analysis on the young
beginning reader that is not required by the Japanese syllabary or the logograph-like characters of Chinese.

Thus, it appears that the acquisition of the ability to segment speech is analogous to the development by man of writing systems, proceeding from the word to the syllable and finally to the phoneme (from meaningful to meaningless units) in a "top-down" fashion.

Other Research Studies Concerning the Difficulty of Segmentation

The difficulty children have with the acquisition of the ability to segment speech sounds has been the concern of several other research studies. Calfee, Chapman, and Venczky (1972) studied the ability of kindergarten children to segment common consonant-vowel-consonant (cvc) words. They found the children able to segment the final vc if it were a meaningful unit like hat-at or sit-it. Children seemed to abstract a semantic rather than a phonological generalization, and this interfered with subsequent tasks with non-meaningful units. In the same battery of tests, the continuants /l/ and /m/ (which are more easily divorced from vowel sounds) were used, and children were asked to tell if a word began with that phoneme, e.g., "The word 'look,' does it begin with l-l-l?" Children were able to perform this task only at chance level. Although the authors stated that it is possible that these kindergarten children may not have been able to understand the tasks asked of them.
(even though they were given training as a first step), it is likely that they simply were unable to segment sound into phonemic units.

Bruce (1964), in order to assess children's ability to analyze words into their constituent phonemic segments, asked children to delete a sound from a word and pronounce the resulting word, e.g., "What word would you have if the t sound were taken out of the word stand?" Only children with a mental age of 7 or above had some success with the task.

Several Russian psychologists (Zaphorozhets & Elkonin, 1971) have found that Russian children have considerable difficulty in analyzing words into sounds. Gibson and Levin (1975) described the work of Zhurova, who in 1962 in an experiment similar to that of Bruce, asked a 3-year-old named "Igor" if his name were "Gor." The child responded, "No, Igor." When asked what had been left out, he could only respond "IIIIGor." In other similar experiments, Zhurova found prereading Russian children unable to isolate phonemes until the age of 7 years without extensive training.

A study by Wallach, Wallach, Dozier, and Kaplan (1977) compared lower-socioeconomic-status children with children from middle-socioeconomic-status. Their findings indicated that virtually no kindergarten child had difficulty with auditory discrimination while almost all of the disadvantaged children did poorly on tasks involving phonemic analysis of words. Numerous studies in the 60s (M. Deutsch, 1963; Clark
Richards, 1966; C. Deutsch, 1964, and others) identified disadvantaged children as having problems with auditory discrimination. The difficulty was attributed to such things as dialect, noise in the environment, etc. It may be that the inability to segment sound was actually the causative factor in the difficulty found by these studies.

**Development of Programs**

Two kinds of reading programs have evolved from studies that have indicated that the barrier to the acquisition of the alphabetic principle may be due to the inability to segment sound into phonemes. The first of these involves teaching a syllabary. Because the research in speech perception seemed to indicate that the syllable is a natural unit for segmentation and far more accessible to the young child, Gleitman and Rozin (1973) used a 23-element syllabary with both inner-city and suburban kindergartners in an attempt to teach the basic notion of sound-tracking uncontaminated by simultaneous introduction of the difficult and inaccessible phonemic unit. The intent of the program was to recapitulate the development of writing systems by beginning with the pictorial representations, and proceeding by steps to rebus and syllables before introducing the highly abstract alphabetic notation.

The second kind of program attempted to train children to segment phonemes. Dorval, Wallach, and Wallach (1978)
reported success in a "tutorial reading program that taught low socioeconomic status children a 'breaking-up' strategy for recognizing starting sounds by separating off the starting phonemes from the rest of a word by a pause" (p. 785). Although this strategy, as it is described by Dorval et al., appears to be contrary to what is known from the work that has been reported here on segmentation (that segmentation is impossible at the physical level), this method is purported by the authors to solve the problem and also is reported by others discussing the problem without qualification.

Rosner (1974) taught a group of 4-year-olds auditory analysis skills organized on eight levels, including clapping the number of sounds in a word, omitting a word from a sentence, then a syllable and a consonant from a word, and finally substituting one initial consonant phoneme for another. He concluded that prereaders as young as 4 years old, living in an inner-city neighborhood, could be taught auditory analysis skills. No effort was made to assess their ability to transfer the training skills to actual reading.

Elkonin, in 1973, developed a training procedure that included a visual model that made the analysis task more easily accomplished. He first gave the child a wooden block to represent each syllable in a word. When the child was able to identify syllables, he then was taught to use the blocks to represent the phonemes. It was only after facility
at this task was achieved that names of the phonemes were associated with the blocks. Although there is little information concerning the specifics of Elkonin's work, it is this first step of using the concrete object to represent the abstract psychological entity of the phoneme that seems to be the most useful method discovered thus far to circumvent the problems that confront the beginning reader as he begins to work with the phonemic unit.

The most recent effort to teach segmentation was reported by Williams (1980) who, in a program called the ABD's of Reading (Analysis, Blending and Decoding), taught phoneme blending, letter-sound correspondence, and decoding to learning-disabled children in New York City. A key feature of the ABD program was the use of the Elkonin block technique to make the segmentation process more concrete. The 2-year program was able to demonstrate transfer to decoding of words not presented in training.

In summary, it is known that a major barrier to the acquisition of the phoneme-grapheme correspondence is the inability of young students to segment the complexly encoded speech stream into phonemic units for the purpose of analysis. It has been demonstrated that the acquisition of the ability to segment sound into phonemic units is analogous to the development of writing systems. There is some evidence that age and socioeconomic status are variables of this ability. Several programs have been formulated to help foster the
development of this ability. However, it must be concluded that the research information available concerning the acquisition of the alphabetic units and the barrier posed by the segmentation-analysis task is in its beginning stages.
CHAPTER III

PROCEDURE OF THE STUDY

Research Design

The purpose of this study was to describe the ability to segment the acoustic stream into phonemic units during the period of beginning reading acquisition. The relationship of this ability to socioeconomic status and achievement in reading was also studied.

Because a 4-year (kindergarten through third-grade) longitudinal study was not feasible, a cross-sectional, descriptive method was chosen. Using this method, the assumption can be made (Sax, 1968) that the groups selected for inclusion are comparable; they represent the same development as might be observed by a longitudinal study. Two social classes at kindergarten through third grade were studied. A random sample was drawn at each grade level at each socioeconomic level.

The Population

Four schools were chosen from a large metropolitan school district. Two schools represented students from low-socioeconomic backgrounds whereas the other two represented students from upper-middle-socioeconomic backgrounds. Two schools were chosen to represent each socioeconomic
background in order to have a parent population of at least 100 at each grade level so that a random sample could be drawn. The criteria for selection of schools was the number of students on free lunch, 90% for the low and 0 to 5% for the high. Validation of the selection, in the form of judgment of school district personnel who knew the characteristics of the school populations, was also obtained.

The two low-socioeconomic schools were third and fifth highest of all schools in the district in terms of percentage of children on free lunch. Two of the schools possessing higher percentages of children on free lunch were predominantly Spanish-speaking and the third school was participating in a special curricular program with a reduced pupil-teacher ratio. Therefore, the two schools chosen to represent low-socioeconomic background were significantly low on the measure of free lunch and eligibility for Title I Programs (educational deprivation). One campus primarily served a federal housing project and the other was located in an old area of the city bordering a fair ground.

The two schools representing high-socioeconomic backgrounds both possessed less than 1% of children on free lunch. The only available index of social class was the free lunch data used for Title I placement. While a high percentage on free lunch can be reasonably interpreted as indicative of economic deprivation, the reverse may not necessarily indicate high-socioeconomic status. Thus, it was necessary
(a) to characterize the advantaged socioeconomic class as high-middle rather than simply high and (b) to depend on the subjective assessments of principals, teachers, the researcher, and others familiar with the schools to validate the selection of these schools. (In reporting the data, the high-middle-socioeconomic class will be referred to as the high-socioeconomic group.) Both schools designated as high-middle-socioeconomic were reported as serving students with professional parents, as having parents involved in school activities, and as being located in neighborhoods with single-family brick homes.

Selection of the Sample

A random sample of 40 subjects was selected from the combined populations of the two low-socioeconomic status schools at each grade level: kindergarten, first, second, and third. The same procedure was used to draw the four grade level groups from the two high-socioeconomic schools. The sample is represented by the following table.

Table 1
Sample Groups

<table>
<thead>
<tr>
<th>Schools</th>
<th>Grade Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>K</td>
</tr>
<tr>
<td>Low SES(^a)</td>
<td>40</td>
</tr>
<tr>
<td>High SES</td>
<td>40</td>
</tr>
</tbody>
</table>

Note. \(N = 320\)

\(^a\)SES is used throughout this paper in tables to indicate socioeconomic status.
Subjects drawn by the randomization process were disqualified for a number of reasons. The various reasons are discussed below.

Letter of Permission

A standard letter of permission, written on letterhead stationery of the school district, was sent to parents of each subject. The letter described the study and asked for written parental permission for participation. See Appendix A. A second copy of the letter was sent if the first one was not returned. Subjects who did not return the letter of permission were dropped from the study. One kindergarten subject from the high-socioeconomic group and twelve kindergarten students from the low-socioeconomic group were dropped. Five first graders from the high-socioeconomic group and eight from the low-socioeconomic group were dropped. Four second graders from the high-socioeconomic group and six from the low-socioeconomic group were dropped. Four third graders were dropped from high-socioeconomic group and four from the low-socioeconomic group were dropped because of failure to return the letter of permission.

The subjects selected by the randomization process and subsequently dropped from each group because of lack of permission letter are summarized by the following table.
Table 2

Subjects Dropped Because of Lack of Permission Letter

<table>
<thead>
<tr>
<th>Schools</th>
<th>Grade Levels</th>
<th>K</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low SES</td>
<td></td>
<td>12</td>
<td>8</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>High SES</td>
<td></td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

One second grader from the low-socioeconomic group was dropped because parents denied permission. Further discussion of the letter of permission is included in the section on limitations.

Lunch Status

No subject from a high-socioeconomic school who qualified for free or reduced lunch was included, and no subject from a low-socioeconomic school who did not qualify for free lunch was included. Two kindergarten subjects were dropped, one from the high-socioeconomic group and one from the low-socioeconomic group. Two first graders were dropped, one from the high-socioeconomic group and one from the low-socioeconomic group. One second grader was dropped from the low-socioeconomic group. The number of subjects selected by the randomization process and subsequently dropped because of the lunch classification is summarized in the table below.
Non-English-Speaking Subjects

The four schools were chosen so as not to include predominantly non-English-speaking communities. Any non-English-speaking child selected was dropped from the study. Four kindergarten students were dropped, two from the high- and two from the low-socioeconomic groups. One first grader from the high-socioeconomic group and four from the low-socioeconomic group were dropped. One second grader from the high-socioeconomic group and three from the low-socioeconomic group were dropped. Three third graders from the high-socioeconomic group and two from the low-socioeconomic group were dropped. The subjects selected by the randomization process and subsequently dropped because of the non-English speaking designation are summarized in Table 4.

Transferred Subjects

Six students transferred to other schools between the time the sample was selected and the time the testing
Table 4
Subjects Dropped Because of Non-English Speaking Backgrounds

<table>
<thead>
<tr>
<th>Schools</th>
<th>Grade Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>K</td>
</tr>
<tr>
<td>Low SES</td>
<td>2</td>
</tr>
<tr>
<td>High SES</td>
<td>2</td>
</tr>
</tbody>
</table>

occurred. These included two students from the kindergarten low-socioeconomic group, one from the first grade high-socioeconomic group, two from the second-grade high-socioeconomic group, and one from the third-grade high-socioeconomic group.

**Auditory Screening**

Any child who failed the auditory screening done by the school district was dropped as a subject. This group included six children: one from the kindergarten low-socioeconomic group, three from the second-grade high-socioeconomic group, and two from the second-grade low-socioeconomic group.

**Administrative Error**

Two subjects from the kindergarten high-socioeconomic group were dropped because of selection error. One subject from the kindergarten low-socioeconomic group and one subject from the second-grade high-socioeconomic group were not tested due to error.
A summary of the subjects disqualified in each group is described in the table below.

**Table 5**

Summary of Disqualified Subjects

<table>
<thead>
<tr>
<th>Reason for disqualification</th>
<th>Total drawn</th>
<th>No permission letter</th>
<th>Permission denied</th>
<th>Lunch disqualification</th>
<th>Non-English speaking</th>
<th>Transferred</th>
<th>Auditory screening</th>
<th>Administrative error</th>
<th>Total tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>High SES K</td>
<td>40</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>34</td>
</tr>
<tr>
<td>Low SES K</td>
<td>40</td>
<td>12</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>High SES 1st</td>
<td>40</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>Low SES 1st</td>
<td>40</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>High SES 2nd</td>
<td>40</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>Low SES 2nd</td>
<td>40</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>High SES 3rd</td>
<td>40</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>Low SES 3rd</td>
<td>40</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>34</td>
</tr>
</tbody>
</table>

Note. \( N = 236 \)

The Subjects

A description of the subjects is gained by looking at the criteria for sample selection. The criteria for selection of the low-socioeconomic subjects were, (a) one who
qualified for free lunch, (b) one who was from an English speaking home, (c) one who was not enrolled in special education, (d) one who was given parental permission to participate in the study, and (e) one who had not failed the school district's auditory screening test. The high-socioeconomic subject was identical except that he was not qualified for free or reduced lunch.

The only other significant characteristic known about each subject was grade level: kindergarten, first, second, or third. Dates of birth were checked and subjects who were "too old" or "too young" as indicated by the district's cut-off dates were noted. Some discrepancies resulted from retentions, some from "holding back" students whose birthdays were on the borderline, and some from the subjects' having begun school elsewhere where the cut-off dates were different, resulting in "younger" children. The discrepancies of age represented a small proportion of the subjects of the sample (.067). The range of the discrepancy was in all cases less than 9 months plus or minus the standard age. Thus, it was determined that this factor would not be treated separately.

**Teacher Influence**

Subjects were drawn from 26 different classes so that 26 different teachers were represented. In addition, if one considers the years each subject has been in school and may
have had a teacher who has influenced the ability to segment phonemes, the number of teachers is perhaps as high as 75. Thus, no individual teacher is likely to have had an undue influence on the student's ability to segment sounds. Because of the personnel assignment policy of the school district, there is no reason to suspect that teachers in the high-socioeconomic schools differed from those of the low-socioeconomic schools in any biasing manner.

The Instrument

The purpose of the instrument was to determine if the subject could segment the acoustic stream into phonemic units between the initial consonant and the medial vowel. The instrument consisted of six components, all of which were administered individually. Components A, B, and C were screening components. Components D, E, and F were actual test components.

The format for the discussion of each component will be (a) to provide a description of the component, (b) to give an example, and (c) to relate the rationale for the inclusion of each component.

Screening Component A: Auditory Acuity

Description. Component A determined if subjects could, in fact, hear the words that were spoken to them for analysis. The examiner simply asked the subject to repeat a word that she said. Words beginning with 20 consonant letters were used: b, c, d, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, y, and z.
The test words were all three- or four-letter words that had a possible rhyme so that if the subject could hear all the sounds except for the beginning one, that knowledge alone would not insure success.

Example. For example, the word representing the /b/ sound was boy, which might possibly have been mistaken by a child with poor acuity to be toy, Roy, etc. A word like bicycle was not chosen because of the lack of rhyme possibility for guess in the event of partial acuity.

Rationale. The rationale for this component of the test was based on the work of Blank (1968), who established that, if a child could repeat a word spoken to him, the assumption could be made that his auditory acuity was of sufficient quality that it would not interfere with (but not assure) his ability to analyze the separate sounds of words. In other words, the ability to repeat a word does not indicate the ability to analyze the word, only the ability to hear it as a unit.

If a subject had been unable to demonstrate the acuity, by repeating words that were spoken to him, a valid test could not have been administered.

Screening Component B: "Same" and "Different" Concept

Description. This component explained, tested, and then trained, if necessary, the understanding of the concepts "same" and "different" with regard to sound.
Example. For example, the examiner showed the subject a small bell and two wooden blocks. She explained and demonstrated that if she rang the bell twice, he or she heard the same sound two times. She then repeated the procedure with the blocks. Finally, she explained and demonstrated "different" sounds by using one ring of the bell and one "clack" of the blocks. The test procedure featured immediate correction and training on each item if the subject were unable to make "same" and "different" judgments easily.

Rationale. Although it might reasonably be assumed that school-age children were able to understand the "same" and "different" concept, Component B insured that they had the understanding and could utilize it in order to make judgments regarding sounds.

If a subject was unable to make "same" and "different" judgments on this training component, even after training, a valid test could not be administered.

Screening Component C: Concept of "Beginning"

Description. The third screening component explained, tested, and then trained, if necessary, the understanding of the concept of "beginning" with regard to sound sequence.

Example. The examiner said three numerals and then pointed out which numeral was said in the "beginning." The words "first" and "start" were used synonymously with
"beginning" if any difficulty was encountered. After the examiner had done two examples for the subject and explained each, she proceeded to test the subject's ability to judge which numeral was said at the "beginning" of a sequence. The test procedure featured immediate correction and training on each item if the subject were unable to make the correct "beginning" designation.

Rationale. Although it was expected that most school-age children understand the concept of "beginning" when it refers to the "beginning of the day," "the beginning of a line," etc., it was expected that the concept of "beginning" with regard to sound sequence would be more difficult, especially for the younger subjects in this study. This component attempted to insure that this understanding was possessed by all subjects and, if not, that the deficiency was recognized. If a subject was unable to make the judgment of "beginning" correctly with regard to the sequence of numerals presented in this component, a valid test could not be administered.

Test Component D: "Same-Different" Judgment with Synthetic Words

Description. Component D discerned whether the subject was able to analyze words which began with same and different consonant phonemes in order to make a "same-different" judgment. The test required the subject to assess the
19 sounds in both a "same" situation and a "different" situation. Both words differed in all elements except for the beginning consonant (which may or may not have differed), so that the "same-different" judgment was necessarily made on the basis of the beginning consonant. The same number of each of the five vowels was used in a random order. The same was true of the inclusion of the final consonants.

Example. A format similar to that used by Wepman (1966) to determine auditory discrimination was utilized. The subject was told that the examiner would say two words and that he must tell whether the two words began with the same sound or with different sounds. For example, in the practice exercise, the examiner said, "Paz, pin. Do those begin with the same sound or with different sounds?" Three practice pairs preceded the actual test of the 38 pairs. For the actual test, the subject was seated so that he could not see the examiner's lips as she said the word pairs in order to insure that the judgment was based solely on auditory stimulus.

Rationale. This component (D) was deemed the most important test of the ability to work with beginning consonant phonemic units. The task of segmentation of the initial consonant phoneme requires that the learner (a) auditorily discriminate the words, (b) segment, at the psychoacoustic
level, the beginning consonant from the vowel which follows it, (c) compare or analyze the likeness or difference in the beginning sounds, and (d) finally make a judgment as to whether the two words begin with the same sound or with different sounds. This four-step sequence was required by this component.

Test Component E: Picture Match to Sample

Description. This test component was similar to Component D except that it utilized actual words and, in addition, provided a concrete aspect (picture) to aid auditory memory in the analytic process. The subject was required to look at a sample picture and then to choose from two other pictures the one that began with the same sound as the sample. As in the previous test, all three words differed in all elements except the beginning consonants, which may or may not have differed, so that a "same-different" judgment was necessarily made on the basis of the beginning consonant sound. Nineteen consonant sounds were included. The same number of each of the five vowels was used in random order. The same was true regarding inclusion of final consonant sounds.

Example. For example, in the practice exercise, the examiner showed the picture of a cup set off by a dark lined
box at the top of the page. The subject was required to choose, from pictures of a bed and a cat, the picture which began like the sample picture, cup.

Rationale. This component (E) was included because the synthetic words utilized by the previous component could have proven to be so foreign as to distract some children, especially the kindergarten and first graders. A perfect score on this component does not alone indicate mastery of the skill because it is possible that a subject could have matched/to/sample on the basis of knowing how to spell the word rather than on the basis of being able to auditorily segment the phonemes and make the "same" or "different" judgment. However, since there were 57 different words used in this component, a significant score on this component would represent a considerable amount of memorization if it were done in the absence of the skill being tested. Component E was included because it could help to provide a more complete picture of the mastery than could be provided by using only the synthetic words.

Component F: Deletion of a Phoneme

Description. The last test component (F) required the subject to delete a consonant sound from a word to make a new word.

Example. For example, the examiner told the subject that if she took a sound from the word sit, she could make
a new word, it. After two additional examples, the subject was then asked to do two tasks where the beginning consonant was the only possible deletion and one task where, when using the word steam, the s or the t could have been deleted.

Rationale. The rationale for Component F was taken from the work of Bruce (1964), who found that some children with a mental age of 7 and above were able to work with sound segmentation well enough to manipulate the phonemes to the point of removing a sound from a given word to make a new word. There were only three items in this section, and they were intended to show a mature application of the skill being tested.

Reliability of the Instrument

The reliability of Components D and E of the instrument was established separately at each grade level by the use of the split-half technique. The tests of 15 of the subjects were chosen randomly. These tests were split into half, utilizing the odd/even numbers of items as a basis for the division. A Pearson correlation coefficient was calculated and the Spearman-Brown prophecy formula was used to compensate for the fact that reliability was estimated from a test one-half the length of the final form.

The coefficients for the kindergarten tests were .91 for Component D and .74 for Component E. The coefficients for the first-grade tests were .97 for Component D and 1.00
for Component E. The coefficients for the second-grade tests were .86 for Component D and .92 for Component E. The coefficients for the third-grade test were .95 for Component D and 1.00 for Component E. The following table summarizes the corrected correlation coefficients.

Table 6
Correlation Coefficients for Reliability
Of Test Components

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Components</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td></td>
<td>.91</td>
<td>.74</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>.97</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>.86</td>
<td>.92</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>.95</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Content Validity of the Instrument

Content validity was established by submitting the instrument to a panel of experts composed of two doctoral students in reading, one reading specialist, and one professor of reading, who concurred with the researcher's contention that this instrument does measure the ability to segment speech between the initial consonant and the medial vowel.
Construct Validity of the Components

Screening Component A

Auditory acuity is necessary in order to perform the acoustic task to be tested here. Thus, it was necessary to screen out any subject who was unable to hear words spoken to him. This component asked a subject to repeat words spoken to him in order to assure that this prerequisite acuity was present.

Screening Components B and C

These components tested two concepts that were necessary to perform the test skill. The two concepts were (a) "same-different" with regard to sound and (b) "beginning" with regard to position in a sequence of sounds. Component B explained, tested, and trained, if necessary, the understanding of "same" and "different" with regard to sound by utilizing a test of non-speech sounds. If a subject could not evidence understanding of this concept, a valid test could not be administered and the subject was dropped from the study. Component C explained, tested, and trained, if necessary, the understanding of the concept of "beginning" with regard to position in a sequence of sounds by the utilization of a test of numerals in a sequence. If a subject could not evidence understanding of this concept, a valid test could not be administered, and the subject was dropped from the study.
Test Component D

This component was deemed to be the most important test of the ability to segment the acoustic stream into phonemic units. In the context of synthetic words, the subject was required (a) to auditorily discriminate the words, (b) to segment, at the psychoacoustic level, the beginning consonant from the vowel which followed it, (c) to compare or analyze the likeness or difference of the beginning sounds, and, finally, (d) to make a judgment as to whether the two words began with same or different sounds. Because all other elements in the pair of words differed, judgment was necessarily made on the basis of the beginning consonant.

Test Component E

This component was deemed to be the test that most closely resembles the actual beginning reading skill to be assessed, that of determining which "real" words begin alike and which do not. This test would have provided the ultimate test of the ability were it not for the possibility that a subject might have learned the spelling of these words previously and have made the "same" or "different" judgment on the basis of paired association rather than on the basis of segmentation of the initial consonant from the vowel. However, since there were 57 words used in this component, a significant score on this component represented a considerable amount of memorization if it were done in the absence
of the skill being tested. This component was included because of its close resemblance to the actual task and because the test of synthetic words could have proven to be so foreign as to provide a distraction to some children.

Test Component F

This component, which required the subject to delete a phoneme from a known word, was included because it could indicate a mature application of the skill tested. The underlying concern of this investigation was to determine which children could segment the acoustic stream to identify phonemic units so that concept learning of the phoneme-grapheme correspondence could occur. The deletion of a phoneme required by this component goes beyond this concept learning and probably represents, in addition to a sophisticated application of the ability to segment, considerable experience or practice in using the phonemic unit.

Only three items were included in this component, and, because of the question of reliability, data obtained from it were not treated statistically. The information gained on this component, however, helps to further describe a mature ability to work with the skill.

Examiners

Selection and Training

Two examiners were selected from the school district's list of approved substitute teachers. Examiners demonstrated
a full understanding of the skill to be measured as well as of the test instrument. The examiners were trained by the researcher with two children in order for each examiner to gain proficiency in the administration. All dialogue to be used was provided in capital letters in the Administration of the Test section. Care was taken to include, in the instruction for the administration of each test, a description of possible responses that might occur, as well as instructions as to how to deal with them. The examiners were directed that their function was simply to assess (not instruct) by using the test instrument.

Two examiners were used. Both were former teachers and of about the same age. Both were Anglo females.

Interexaminer Reliability

Interexaminer reliability was established by evaluation of the tape recordings made of every tenth administration of the test by the researcher and another reading specialist on three criteria: (a) dialogue used as prescribed by the test, (b) number of "prompts" or extraneous explanations given, and (c) length of time spent testing each subject.

All dialogue prescribed by the test instruction was adhered to by both examiners. No evidence was found on the tape recordings of prompts or extraneous explanations other than those allowed for in the Instructions to the Examiner. Both examiners spent longer in the administration of the test
to younger students than was spent on the administration of the test with the older subjects. The test required approximately 20 minutes for the kindergarten and first-grade subjects and 15 minutes for the second- and third-grade subjects.

It was necessary for both examiners to administer more training trials to the lower-socioeconomic subjects (especially with the younger subjects) than was needed by the high-socioeconomic subjects. Therefore, the time required to administer the test to the younger low-socioeconomic subjects was longer for both examiners.

The fact that the sample was drawn from the combined populations at two schools made the number of subjects tested by each examiner vary unpredictably. Thus, instead of a systematic sampling of all administrations, the taping provided a random sampling of administrations.

The examiners were assigned so that each examiner tested all grade levels in each socioeconomic group. Thus, one examiner tested grades kindergarten and first at one low-socioeconomic school and grades two and three at the second low-socioeconomic school, etc. This was done so that any examiner bias that might have existed would have been evenly distributed.

As a further test of interexaminer reliability, a t test of the means of the groups tested by each examiner was made to determine if a significant difference existed. A
significant difference was found for two of the eight groups, the first grade high-socioeconomic group and the second grade high-socioeconomic group. The following table summarizes the findings of the tests of significance.

Table 7
Comparison of Mean Scores of Groups
Tested by Each Examiner

<table>
<thead>
<tr>
<th>Group</th>
<th>Examiner 1</th>
<th></th>
<th>Examiner 2</th>
<th></th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K-low</td>
<td>33.56</td>
<td>6.52</td>
<td>28.67</td>
<td>3.21</td>
<td>1.13</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>(9)</td>
<td>(3)</td>
<td>(3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-low</td>
<td>40.24</td>
<td>13.45</td>
<td>40.33</td>
<td>7.07</td>
<td>-0.02</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>(17)</td>
<td>(9)</td>
<td>(9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-low</td>
<td>49.53</td>
<td>8.23</td>
<td>47.30</td>
<td>8.88</td>
<td>0.64</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>(17)</td>
<td>(10)</td>
<td>(10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-low</td>
<td>53.44</td>
<td>4.68</td>
<td>49.83</td>
<td>7.41</td>
<td>1.59</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>(16)</td>
<td>(18)</td>
<td>(18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K-high</td>
<td>44.09</td>
<td>10.88</td>
<td>41.50</td>
<td>9.61</td>
<td>0.68</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>(11)</td>
<td>(22)</td>
<td>(22)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-high</td>
<td>51.00</td>
<td>7.32</td>
<td>55.39</td>
<td>3.65</td>
<td>-2.14</td>
<td>.02 &lt; p &lt; .05</td>
</tr>
<tr>
<td></td>
<td>(14)</td>
<td>(18)</td>
<td>(18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-high</td>
<td>54.62</td>
<td>4.59</td>
<td>58.13</td>
<td>1.63</td>
<td>-2.74</td>
<td>P &lt; .01</td>
</tr>
<tr>
<td></td>
<td>(13)</td>
<td>(16)</td>
<td>(16)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-high</td>
<td>57.18</td>
<td>2.79</td>
<td>58.42</td>
<td>1.98</td>
<td>-1.51</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>(17)</td>
<td>(19)</td>
<td>(19)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There exists the possibility that because the examiners were testing subjects at different schools who were assumed
to be comparable (both high-socioeconomic in this case), the subjects themselves differed and this accounts for the difference found by this test.

**Administration of the Test**

The test instrument was administered individually to all subjects during the months of October and November. All third-grade students were tested first; testing proceeded in sequence so that kindergarten subjects were the last to be tested. The school to be tested first at each grade level was randomly selected. The test administration took approximately 15 to 20 minutes. A quiet room was required at each school for a valid administration of the test.

All six components of the test had two parts: (a) **Administration of the Test**, which instructed the examiners in capital letters exactly what they were to say, as well as other instruction and explanations in lower case type, and (b) **Score Sheet**, on which responses were indicated. The score sheet was attached to a clipboard during the testing situation and held in such a way that the child was unable to see how the responses were marked.

Samples of the Administration of the Test and the Score Sheet are given for a screening and a test component in Appendix B.
Procedures for Analysis of the Data

Hypothesis 1 stated that a significant difference in the ability to segment speech sound into phonemic units would exist between the two socioeconomic classes at each grade level. The $X^2$ approximation (for large samples) of the Kruskal Wallis Test was used to determine if a significant difference existed between the ranks of the two socioeconomic groups on both criterion measures (D and E) at each grade level. A tie correction factor was used.

Hypothesis 2 stated that a developmental-like trend would be observed in each of the socioeconomic groups so that the mean score of the kindergarten group < the mean score of the first-grade group < the mean score of the second-grade group < the mean score of the third-grade group. A table is used to report the means and standard deviations for each group in order to determine if a developmental-like trend existed.

Hypothesis 3 stated that a statistically significant correlation would exist between ability to segment the acoustic stream into phonemic units and achievement in reading. A Pearson correlation coefficient was calculated in order to establish if a relationship existed between the scores of the second and third graders on both criterion measures (D and E) and the measure of reading achievement.

Mastery was arbitrarily defined as a score of 80% or higher on the criterion variable, and the percentage of subjects who achieved mastery is reported for each group.
CHAPTER IV

RESULTS, DISCUSSION, AND CONCLUSIONS

Results

The problem of this study was to identify the beginning reader's ability to segment speech sound into phonemic units. Four purposes were formulated to address this problem. Each purpose along with the hypotheses and the findings will be presented here. Each purpose will be addressed with data obtained from Component D (test of synthetic words) and Component E (test of actual words). Further findings indicated by information gained from Component F (deletion of a phoneme), as well as information gained from the screening components will be presented.

Effect of Socioeconomic Status

The first purpose of this study was to ascertain if a difference existed between high- and low-socioeconomic groups' ability to segment speech sound into phonemic units. It was hypothesized that a significant difference in the ability would exist between the two socioeconomic groups at each grade level. The raw scores obtained on Test Components D and E were ranked and subjected to a Chi Square approximation of the Kruskal Wallis Test with correction for tie. A significant difference ($p < .05$) was found between
the ranks of the scores of the high- and low-socioeconomic groups at each grade level. At each grade level the low-socioeconomic group was less able to perform the task. Table 8 summarizes the findings of the Chi Square approximations.

Table 8

Probabilities Associated with the Chi Square Approximation of the Kruskal Wallis Test

<table>
<thead>
<tr>
<th>Grade Levels</th>
<th>Components</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>p = .0210</td>
<td></td>
<td>p = .0001</td>
</tr>
<tr>
<td>1</td>
<td>p = .0001</td>
<td></td>
<td>p = .0001</td>
</tr>
<tr>
<td>2</td>
<td>p = .0001</td>
<td></td>
<td>p = .0300</td>
</tr>
<tr>
<td>3</td>
<td>p = .0001</td>
<td></td>
<td>p = .0130</td>
</tr>
</tbody>
</table>

It can be concluded from these data that the low-socioeconomic groups were less able to segment speech sounds into phonemic units, at each grade level considered to comprise the years of beginning reading, than were their counterparts from the high-socioeconomic groups.

Effect of Age

The second purpose of this study was to determine if a developmental-like trend existed in the ability to segment speech sounds into phonemic units. It was hypothesized that
a developmental-like trend would exist so that mean scores of
the kindergarten group < mean scores of the first-grade
group < mean scores of the second-grade group < mean scores
of the third-grade group. The means of each group illustrate
the trend found.

The means of the low-socioeconomic group on Component D
were 20.58 (SD = 4.12) at kindergarten; 24.50 (SD = 8.94) at
first grade; 30.22 (SD = 7.21) at second grade; and 32.03
(SD = 5.63) at third grade.

The means of the high-socioeconomic group on Component D
were 25.88 (SD = 7.52) at kindergarten; 34.22 (SD = 4.13)
at first grade; 36.48 (SD = 2.52) at second grade; and 36.81
(SD = 1.82) at third grade.

The means of the low-socioeconomic groups on Component E
were 11.75 (SD = 3.19) at kindergarten; 16.12 (SD = 4.00) at
first grade; 18.04 (SD = 1.70) at second grade; and 18.63
(SD = 1.26) at third grade.

The means of the high-socioeconomic groups on Component E
were 16.36 (SD = 2.96) at kindergarten; 18.84 (SD = 0.72) at
first grade; 18.83 (SD = 0.54) at second grade; and 19.00
(SD = 0.00) at third grade.

The means of the low-socioeconomic group on Component F
were .00 at kindergarten, .04 at first grade, .44 at second
grade, and .74 at third grade.

The means of the high-socioeconomic group on Component F
were .15 at kindergarten, .59 at first grade, 1.48 at second
grade, and 2.28 at third grade. No standard deviations are reported for Component F because it consisted of only three items. Table 9 reports the means and standard deviations for each group.

Table 9
Mean Scores and Standard Deviations of Test Components by Socioeconomic Status and Grade Level

<table>
<thead>
<tr>
<th>Socioeconomic Status</th>
<th>Grade Level</th>
<th>K</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low SES</td>
<td>Component D</td>
<td>Mean</td>
<td>20.58</td>
<td>24.50</td>
<td>30.22</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>(4.12)</td>
<td>(8.95)</td>
<td>(7.21)</td>
<td>(5.63)</td>
</tr>
<tr>
<td></td>
<td>Component E</td>
<td>Mean</td>
<td>11.75</td>
<td>16.12</td>
<td>18.04</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>(3.19)</td>
<td>(4.00)</td>
<td>(1.70)</td>
<td>(1.26)</td>
</tr>
<tr>
<td></td>
<td>Component F</td>
<td>Mean</td>
<td>0.00</td>
<td>0.04</td>
<td>0.44</td>
</tr>
<tr>
<td>High SES</td>
<td>Component D</td>
<td>Mean</td>
<td>25.88</td>
<td>34.22</td>
<td>36.48</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>(7.52)</td>
<td>(4.13)</td>
<td>(2.52)</td>
<td>(1.82)</td>
</tr>
<tr>
<td></td>
<td>Component E</td>
<td>Mean</td>
<td>16.36</td>
<td>18.84</td>
<td>18.83</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>(2.96)</td>
<td>(0.72)</td>
<td>(0.54)</td>
<td>(0.00)</td>
</tr>
<tr>
<td></td>
<td>Component F</td>
<td>Mean</td>
<td>0.15</td>
<td>0.59</td>
<td>1.48</td>
</tr>
</tbody>
</table>

A test of the analysis of variance was considered for this study. However, because of the possibility of
violating the underlying assumption of the analysis of variance test for normality of distribution, this test was not made. The trait being measured, the ability to segment phonemes, does not appear to be normally distributed in the population. Frequency distributions of the scores on each component at each grade level can be seen in Figures 4-7.

These data indicate that the mean score of the kindergarten group < the mean scores of the first-grade group < the mean scores of the second-grade group < the mean scores of the third-grade group, with the exception of the high-socioeconomic groups at the first and second grades on Component E. The first-grade means were .0162 greater than the second-grade means. This difference is probably insignificant in that the scores of both groups were not more than .1724 from a perfect score on the test of 19 items. The third-grade mean was at a perfect score of 19.

These data appear to indicate that a similar developmental-like trend existed in the performance of both socioeconomic groups on all three of the test components but that the rate at which the two groups proceeded was markedly different. On Component E, the low-socioeconomic group was approximately one year behind the high-socioeconomic group so that the high-socioeconomic kindergarten score was about equivalent to the score of the low-socioeconomic group
at first grade, etc. On Component D, the low-socioeconomic groups appeared approximately two years behind the high-socioeconomic groups, so that the high-socioeconomic first graders were at about the same level as the low-socioeconomic group at third grade. In addition, the mean of the third-grade low-socioeconomic group fell almost six points short of a perfect score of 38 while the mean of the third-grade high-socioeconomic group was only about one point short of a perfect score.

The means of Component F for the two groups were roughly equivalent to the means of Component D with the high-socioeconomic groups exceeding the low group by large measures so that the first-grade subjects of the high-socioeconomic group were roughly equivalent to the third-grade low-socioeconomic group.

Graphs of means for each group on each component are presented in Figure 1.

**Correlation with Reading Achievement**

The third purpose of this study was to determine if the ability to segment speech sound into phonemic units was significantly correlated with achievement in reading. It was hypothesized that a statistically significant correlation would exist. A Pearson correlation coefficient was calculated between the raw scores of the second and third graders on the *Iowa Tests of Basic Skills, Word Analysis Subtest,*
Fig. 1—Mean scores for each grade level by SES Group on Components D, E, and F.
and the scores on Components D and E. A statistically significant correlation was found at each level on Component D and at second grade on Component E. All of the coefficients were probably depressed because of the lack of variability of the scores on test components. There was a marked lack of variability on Component E.

The second grade coefficients and levels of significance were, Component D, \( r = .35, p = .006 \); Component E, \( r = .34, p = .007 \). The levels for third grade were, Component D, \( r = .53, p = .001 \); Component E, \( r = .15, p = .123 \).

Spearman correlation coefficients calculated between the Iowa Tests of Basic Skills, Word Analysis Subtest percentile scores and Components D and E were higher. The coefficients and levels of significance for second grade were, Component D, \( r_s = .33, p = .008 \); Component E, \( r_s = .40, p = .002 \). The coefficients and levels of significance for third grade were, Component D, \( r_s = .70, p = .001 \); Component E, \( r_s = .24, p = .034 \).

Proportion of Mastery

The fourth purpose of this study was to determine the proportion of subjects at each grade level on each test component who were able to achieve a mastery score arbitrarily set at 80%. The findings indicated that at kindergarten no low-socioeconomic subjects were able to demonstrate mastery on Component D, while 14% were able to demonstrate
mastery on Component E. Twenty-six percent of the kindergarten subjects from the high-socioeconomic group were able to score mastery on Component D, while 17% scored mastery on Component E.

Of the low-socioeconomic first graders, 30% were able to demonstrate mastery on Component D, while 74% were able to demonstrate mastery on Component E. Of the high-socioeconomic first graders, 88% were able to demonstrate mastery on Component D, and all scored mastery on Component E.

Of the low-socioeconomic second graders, 63% scored mastery on Component D, and 96% scored mastery on Component E. Of the high-socioeconomic second graders, 90% scored mastery on Component D, and all scored mastery on Component E.

Of the low-socioeconomic third graders, 71% scored mastery on Component D, and 97% scored mastery on Component E. Of the high-socioeconomic third graders, all scored mastery on both Components D and E.

This information is shown in Table 10. The same information is graphically represented in Figure 2.

Screening Data

The first three components of the instrument screened for abilities deemed to be prerequisite to the ability to segment speech sound into phonemic units. The first ability tested was auditory acuity. The subjects were required to
Table 10
Percent of Students Achieving Mastery on Each Component by Grade Level and SES

<table>
<thead>
<tr>
<th>Socioeconomic Status</th>
<th>Grade Level</th>
<th>K</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Component D</td>
<td></td>
<td>00%</td>
<td>30%</td>
<td>63%</td>
<td>71%</td>
</tr>
<tr>
<td>Component E</td>
<td></td>
<td>14%</td>
<td>74%</td>
<td>96%</td>
<td>97%</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Component D</td>
<td></td>
<td>26%</td>
<td>88%</td>
<td>90%</td>
<td>100%</td>
</tr>
<tr>
<td>Component E</td>
<td></td>
<td>17%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

demonstrate that they could hear words spoken to them for analysis. The second and third components tested two concepts that were necessary to perform the test skill. The two concepts were, (a) "same-different" with regard to sound and (b) "beginning" with regard to position in a sequence of sounds. The results of each screening component will be presented below.

**Auditory acuity.** The acuity screening component of the test was used in addition to the screening done by the health department of the school district. The screening done by the
Fig. 2—Percentage scoring mastery at each grade level by SES Group on Components D, E, and F.
school district covered the whole range of speech sounds but was not available for every child. The screening component of the test was administered to every child regardless of the fact he or she may have passed the screening done by the school district. The auditory screening component did not serve to disqualify any student. Three subjects from the high-socioeconomic group made less than a perfect score of 20. These subjects scored 19, 19, and 17. Some evidence that this screening component was effective is seen by looking at the subject who scored 17. This first-grade subject had passed the auditory screening done by the district, but it had been noted that she was to be "watched." She subsequently scored the lowest of all 236 subjects on the measure of auditory acuity.

Four low-socioeconomic subjects made a less than perfect score on the auditory screening component. These scores were 19, 19, 19, and 18.

"Same-different" concept. The "same-different" concept appeared to be a problem for some subjects. Five kindergarteners from the low-socioeconomic group failed this component and were not tested. Children in all other groups were able to demonstrate that they understood the concept of "same-different."

Concept of "beginning." The concept of "beginning" with regard to sequence of sound was a problem for one
kindergarten subject from the high-socioeconomic group and for seven kindergarten subjects from the low-socioeconomic group (two of whom also failed the "same-different" concept screening). One first grader from the low-socioeconomic group failed to demonstrate understanding of the "beginning" concept on the screening component.

Thus, eleven subjects were unable to demonstrate understanding of the concepts deemed necessary to perform the segmentation task.

Discussion

In order to draw conclusions from the results presented above it is necessary to compare the data concerning central tendencies (means), the dispersion (standard deviations and frequency distributions), the mastery data, and the correlational data. The following discussion will present comparative data concerning,

1. the best test of the ability to segment sound into phonemic units;
2. the effect of the socioeconomic status variable;
3. the effect of the age variable;
4. the dimensions of the ability;
5. the relationship of this ability to achievement in reading; and
6. the prerequisite concepts necessary to test the ability to segment speech into phonemic units.
Test of the Ability

A valid test of the ability to segment speech sounds into phonemic units and to make analysis ("same-different" judgment) requires different tests for different age levels. This is necessitated because of the existence of an intervening variable. With older students, the knowledge of the spelling of actual words appears to act as an intervening variable and causes test results to appear as though the segmentation ability is being measured when actually the spelling skill may be being measured. Thus, it is necessary to measure the ability of older students by the use of a test of synthetic words. The use of a test of synthetic words with younger subjects appears to be inappropriate to their developmental level and unnecessary because the spelling skill has not yet been learned.

In order to understand the ability being tested by each test component and the best test of the ability at each grade level, it is necessary to make grade level comparisons of the results on the different test components by each socioeconomic group.

Test of kindergarten students. Component E, the test of actual words, appeared to function as a valid test of the ability to perform the segmentation task for kindergarteners of both socioeconomic groups. When asked whether cup began like bed or cat, the kindergarten student who could answer
cat appeared to do so because he could segment the consonant /k/ from the vowel which followed it and make a correct judgment as to "same" or "different" with regard to the beginning consonant phonemes /k/-/b/ or /k/-/k/. This test of actual words in the match-to-sample situation was easier to perform than the test of synthetic words, which required a judgment of "same-different" because it (a) utilized concrete pictures so that the sounds did not have to be held in memory while analysis was made, and (b) used familiar words that were probably easier to hold in memory.

A comparison of the results of the mastery levels of the test of actual words with the test of synthetic words revealed great discrepancies for both socioeconomic groups at the kindergarten level. In each case, the percentage mastering the easier task (the task of actual words) was greater. The fact that the mean score of the low-socioeconomic kindergarten group was approximately at chance level on both these measures indicates that most of these children do not possess the segmentation ability. The mean scores of the kindergarteners from the high-socioeconomic group were significantly above chance on both tests, but the discrepancy in percent of mastery on the two tests probably indicates that the test of synthetic words was too difficult for the age group. Thus, the most appropriate test of the segmentation ability for both socioeconomic groups at kindergarten is the test of actual words (Component E).
Test of first graders. First graders from the low-socioeconomic group scored similarly to kindergarteners from the high-socioeconomic group. Mean scores on both tests of actual and synthetic words were significantly above chance. However, the discrepancy between the two tests again probably indicates that the test of synthetic words was too difficult for the developmental level of the age group. Thus, the test of actual words (Component E) appears to be the best test of the ability. Scores of first graders from the high-socioeconomic group on the two components revealed, for the first time, little discrepancy in level of mastery. Here the possibility exists that the mastery on the test of actual words is due to spelling ability and not to segmentation ability. Although spelling instruction was not included in the curriculum for these students, they may have learned spelling patterns by reading actual words. It is evident from the high level of mastery on both tests that most first graders from the high-socioeconomic group do have the ability to perform the segmentation task. It is probable that this is the level of demarcation and that both the test of actual words and the test of synthetic words are necessary to measure this ability.

Test of second and third graders. The evidence of the presence of the intervening variable inherent in the test of actual words is seen in the difference in the levels of
mastery of the two socioeconomic groups at second and third grades. Both groups scored similarly high on the test of actual words, but when low-socioeconomic second and third graders were asked to make a similar judgment using synthetic words, their ability appeared considerably decreased. However, the high-socioeconomic group students' ability did not decrease significantly on the test of synthetic words as it had in the kindergarten group.

Thus, it appears that second and third graders who were able to determine that cup began like cat did not do so because they were able to perform the segmentation-analysis task as the kindergarteners did. They did so because either (a) they had learned by paired association that these two words began alike (probably, further that they both are associated with the grapheme c), or (b) they knew how to spell both words and could assess that both began with the same letter, the letter c.

The test of synthetic words, which required the student to determine if words like muv and mox began alike, required the segmentation of the beginning consonant phoneme from the vowel which followed it and the judgment that both beginning phonemes were the same. The fact that this task was not too difficult for the age group is evident because virtually all of the high-socioeconomic group could accomplish the task as could 70% of the low-socioeconomic group. Both socioeconomic groups scored almost total mastery on the test of actual
words, but a significant number (approximately 30%) of the low-socioeconomic group did not master the test of synthetic words.

The same contrast is seen by comparing the performance of students on the synthetic word component to their performance on the final component, which required deletion of a sound from a word to create a new word. The better the students were able to work with synthetic words, the better they could perform the deletion task. However, success with the actual words did not appear related to the ability to work with the phonemic unit required by the deletion task.

It can be concluded that not all second and third graders from low-socioeconomic background are able to segment speech into phonemic units and that the test of actual words cannot function as a valid test of this ability for this age group.

Table 11 presents the mean scores of each group on each component, as well as the percent scoring mastery.

A summary of the ability measured by each test component and the test deemed to be the most appropriate test of the ability is shown in Table 12.

**Socioeconomic Status Variable**

The data collected on each component indicated that socioeconomic status is a very significant variable related to segmentation ability. The low-socioeconomic students
Table 11
Mean Scores of the Socioeconomic Groups on Components D, E, and F and Per Cents of Mastery

<table>
<thead>
<tr>
<th>Group</th>
<th>Test of Synthetic Words</th>
<th>Test of Actual Words</th>
<th>Deletion Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>Kindergarten</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Mean</td>
<td>20.58</td>
<td>11.75</td>
<td>.00</td>
</tr>
<tr>
<td>% of Mastery</td>
<td>00%</td>
<td>14%</td>
<td>00%</td>
</tr>
<tr>
<td>High Mean</td>
<td>25.88</td>
<td>16.36</td>
<td>.15</td>
</tr>
<tr>
<td>% of Mastery</td>
<td>14%</td>
<td>71%</td>
<td>00%</td>
</tr>
<tr>
<td>First Grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Mean</td>
<td>24.50</td>
<td>16.12</td>
<td>.04</td>
</tr>
<tr>
<td>% of Mastery</td>
<td>30%</td>
<td>74%</td>
<td>00%</td>
</tr>
<tr>
<td>High Mean</td>
<td>34.22</td>
<td>18.84</td>
<td>.59</td>
</tr>
<tr>
<td>% of Mastery</td>
<td>88%</td>
<td>100%</td>
<td>14%</td>
</tr>
<tr>
<td>Second Grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Mean</td>
<td>30.22</td>
<td>18.04</td>
<td>.44</td>
</tr>
<tr>
<td>% of Mastery</td>
<td>63%</td>
<td>96%</td>
<td>07%</td>
</tr>
<tr>
<td>High Mean</td>
<td>36.48</td>
<td>18.83</td>
<td>1.48</td>
</tr>
<tr>
<td>% of Mastery</td>
<td>90%</td>
<td>100%</td>
<td>48%</td>
</tr>
<tr>
<td>Third Grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Mean</td>
<td>32.03</td>
<td>18.62</td>
<td>.74</td>
</tr>
<tr>
<td>% of Mastery</td>
<td>71%</td>
<td>97%</td>
<td>24%</td>
</tr>
<tr>
<td>High Mean</td>
<td>36.81</td>
<td>19.00</td>
<td>2.28</td>
</tr>
<tr>
<td>% of Mastery</td>
<td>100%</td>
<td>100%</td>
<td>75%</td>
</tr>
</tbody>
</table>
Table 12

Ability Measured by Test Components

<table>
<thead>
<tr>
<th>Group</th>
<th>Test of Synthetic Words</th>
<th>Test of Actual Words</th>
<th>Deletion Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindergarten</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Segmentation ability</td>
<td>Segmentation ability*</td>
<td>Mature application of the ability</td>
</tr>
<tr>
<td>High</td>
<td>Segmentation ability</td>
<td>Segmentation ability*</td>
<td>Mature application of the ability</td>
</tr>
<tr>
<td>First Grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Segmentation ability</td>
<td>Segmentation ability*</td>
<td>Mature application of the ability</td>
</tr>
<tr>
<td>High</td>
<td>Segmentation ability*</td>
<td>Undetermined</td>
<td>Mature application of the ability</td>
</tr>
<tr>
<td>Second Grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Segmentation ability*</td>
<td>Paired association</td>
<td>Mature application of the ability</td>
</tr>
<tr>
<td>High</td>
<td>Segmentation ability*</td>
<td>Paired association</td>
<td>Mature application of the ability</td>
</tr>
<tr>
<td>Third Grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Segmentation ability*</td>
<td>Paired association</td>
<td>Mature application of the ability</td>
</tr>
<tr>
<td>High</td>
<td>Segmentation ability*</td>
<td>Paired association</td>
<td>Mature application of the ability</td>
</tr>
</tbody>
</table>

*Most appropriate test for the group.
began kindergarten with significantly less segmentation ability, scoring at about chance level on both the test of synthetic words and the test of actual words. Less than 15% of the low-socioeconomic kindergarten students were able to demonstrate mastery on the test deemed to be the most appropriate test of the ability. High-socioeconomic kindergarten students began school with considerable segmentation ability, scoring well above chance level and above their counterparts in the low-socioeconomic group, with over 70% of the students mastering the test deemed to be the most appropriate test of the ability.

In addition to beginning with less segmentation ability in kindergarten, the low-socioeconomic group performed less well at each subsequent grade level than did their counterparts in the high-socioeconomic group. However, although the low-socioeconomic kindergarten students began school with less ability to perform this task, most (approximately 70%) were able to demonstrate that the ability had developed by early first grade. It is the approximately 30% of the low-socioeconomic students who are unable to perform the segmentation task at first, second, and third grade that account for the most important difference between the socioeconomic groups. The difference in mastery levels by the two socioeconomic groups is graphically presented in Figure 3.

The low socioeconomic group also appeared significantly less able to transfer the skill to a new situation as
Fig. 3—Percentage scoring mastery on test deemed best measure of the ability at each grade level by SES group.
evidenced by the performance on Component F, the deletion task. Even at third grade, only 24% of the low-socioeconomic students were able to demonstrate mastery on Component F while 75% of the high socioeconomic group were able to exhibit mastery.

**Age Variable**

The data collected on each component also indicates that age is a significant variable related to segmentation ability. A developmental-like trend existed so that students at each successive grade were better able to perform the task than were the previous ones. Age alone, however, does not seem to insure the development of this ability, since almost 30% of third graders in the low-socioeconomic group failed to master the component deemed to be the best test of the ability.

It should be noted from Figure 3 that the percentage of mastery for the low-socioeconomic groups remained at about 70% on the best test of the ability at grades one, two, and three. If this information is viewed as though it were longitudinal data, the student who did not possess this ability in the first grade still do not acquire the ability by the third grade. It is probable that instruction regarding the phoneme-grapheme correspondence enabled these students to master the paired-associational task required by the test of actual words in the absence of the segmentation ability.
Dimensions of the Ability

There is little information in the research reports concerning dimensions of this ability. The findings of this study indicate two possible dimensions: (a) the learning task appears to be a mastery task, dependent upon a level of psychological maturity, and (b) the presence of the ability seems to result in concept development when the phoneme-grapheme correspondence is taught.

Mastery learning task. An examination of the frequency distributions of the test considered to be the best test of this ability at each grade level indicates that this task is probably a mastery learning task; either the student "can" or he "cannot" perform the segmentation task. Distributions were positively skewed when the students were unable to perform the task and negatively skewed when they were able to perform. (See Figures 4-7.)

The mastery learning aspect of this ability appears to be dependent upon a level of psychological maturity related to language which may be analogous to the levels of cognitive maturity as described by Piaget (1963). The sharp incline of the low-socioeconomic group seen on the graph of the mastery of the most appropriate test for the grade level seems to indicate that this ability develops during the kindergarten year. (See Figure 3.) It is probable that
Fig. 4—Frequency distributions of scores of the kindergarten groups on Component E.

Note. ——— indicates distribution if those screened out by Components A, B, and C are included at chance level.

Fig. 5—Frequency distributions of scores of first-grade groups on Component E.
Fig. 6—Frequency distributions of scores of second-grade groups on Component D.
Fig. 7—Frequency distributions of scores of third-grade groups on Component D.
a similar incline would have been present had prekindergarten students from the high-socioeconomic group been tested.

Concept development. The data also indicate that the ability to perform the segmentation-analysis task appears to result in concept development when the student works with the beginning consonant phoneme and the phoneme-grapheme correspondence. The student who can segment the beginning consonant from the vowel which follows it seems to form a concept of what the particular consonant phoneme is and also what it is not. The student is then able to use this concept as he or she works with unfamiliar words such as those required by the test of synthetic words. The student who can segment beginning consonant sounds from the vowel which follows can then make judgments that two words begin with the same sound or with different sounds. He or she probably needs only to work with several examples of each of the 19 consonant phonemes. For example, he or she judges that box, book, and boat begin alike on the basis of his segmentation ability. He or she probably then induces a concept of what the phoneme represented by the grapheme $b$ is, and what it is not. Thus, he or she is able to categorize words like bounce, bias, been, etc., as belonging to the /b/ group, and further, that words such as dog, fun, concise, etc., do not belong.

When the ability to segment speech into phonemes is absent, the student working with beginning consonant phonemes
must resort to paired-associational learning. He learns to pair boat and box and may further pair these with the grapheme b, but he is unable to use these associations to make judgments concerning new words he has not previously paired, as was evidenced by inability to work with the synthetic words.

It can be concluded that the ability to segment the beginning consonant phoneme of a word from the vowel phoneme which follows it and to make analysis (judgment of "same" or "different" with regard to the beginning consonant phonemes) is an ability prerequisite to the acquisition of the phoneme-grapheme correspondence. It cannot be assumed that this readiness ability is possessed by all students, especially students from low-socioeconomic backgrounds.

Relationship Between Ability and Reading Achievement

The ability to segment sound into phonemic units and reading achievement (decoding) were positively correlated. The Pearson correlation coefficients calculated between the percentile scores on the standardized measure of reading achievement (word analysis) and the test deemed to be the best measure of the ability (the test of synthetic words) were .33 at second grade and .70 at third grade. These coefficients may be depressed because of lack of variability of the scores on the measure of the segmentation ability.
It appears that the ability to segment speech into phonemic units is more highly correlated with reading achievement as the difficulty of words increases. It should be noted that the tests of achievement were administered at the end of the preceding year, so that the test of second graders was actually a first-grade-level test (ITBS, level 7), and the third graders were tested on a second-grade-level test (ITBS, level 8). It is probable that the correlation was higher at third grade because the test of achievement (word analysis subtest) at this level contains more difficult words and the control of reading vocabulary is decreased. Thus, subjects who relied on memorization (or paired association) probably experienced more difficulty at third grade than they had at second grade. At third grade the coefficient of determination \( r^2 \) accounted for 49% of the variation between the two groups.

**Prerequisite Concepts**

It cannot be assumed that all young children understand the concepts of "same" and "different" with regard to sound and the concept of "beginning" with regard to sequence of sounds. Eleven students (ten of whom were from low-socioeconomic groups) failed to exhibit understanding of these concepts.
Conclusions

On the basis of the results and discussion presented above, the following conclusions can be drawn:

1. The ability of students, during the years of beginning reading acquisition, to segment speech into phonemic units can be measured.

2. Significant differences exist between high- and low-socioeconomic groups at each grade level. Approximately 30% of students from low-socioeconomic groups do not possess this ability during the years of beginning reading acquisition (kindergarten through third grade).

3. The ability to segment speech into phonemic units appears to be a mastery learning task.

4. Presence of the ability to segment speech into phonemic units appears to result in concept development when the phoneme-grapheme correspondence is taught; lack of the ability appears to result in paired-associative learning when the phoneme-grapheme correspondence is taught.

5. The most appropriate test of the ability for younger children is the use of a test involving actual words in the match-to-sample situation. The most appropriate test of the ability for older students should utilize a test of synthetic words requiring a "same-different" judgment.

6. The concepts "same" and "different" with regard to sounds and "beginning" with regard to sequence of sounds are
necessary prerequisites to the ability to perform segmentation and analysis of phonemic units.

7. The ability to segment speech into phonemic units is more highly correlated with achievement in reading as the decoding demands of reading are increased.
CHAPTER V

IMPLICATIONS, RECOMMENDATIONS, LIMITATION, AND SUMMARY

Implications

Several implications for instruction are indicated by the findings of this study.

1. The results of the screening components indicate that it cannot be assumed that all students have the prerequisite concepts necessary to work with, or even to assess the ability to work with, phonemic units. Thus, the educational implication is that concepts of "same-different" with regard to sound and "beginning" with regard to sequence of sounds must be assessed and taught, if necessary, before the ability to segment speech into the phonemic units is assessed or before instruction in the phoneme-grapheme correspondence is initiated.

2. It is necessary to assess the ability of the students to segment speech sounds into the phonemic unit and make analysis (same or different judgment) before instruction in the phoneme-grapheme correspondence can be initiated. Further, one may not validly use a test of actual words to assess this ability with second- and third-grade students.
3. The findings indicated that the placement of phoneme-grapheme correspondence instruction in the curriculum should be different for the different socioeconomic groups. Most high-socioeconomic kindergarten students (70%) appear to have the prerequisite ability to be taught the phoneme-grapheme correspondence in the kindergarten, while most low-socioeconomic students (70%) do not have the prerequisite ability in kindergarten and cannot be taught this correspondence until first grade. The 30% of high-socioeconomic kindergarten students who do not have the ability in kindergarten do acquire the ability by first grade and should then be ready to learn the phoneme-grapheme correspondence as the beginning reading task of first grade.

4. The findings indicated that 30% of the low-socioeconomic students who do not possess the ability to segment speech into phonemic units, do not, during the period of beginning reading acquisition (kindergarten through third grade), acquire this ability. Thus, the educational implication is that (a) these students be instructed by an approach to beginning reading that minimizes the importance of the sound-symbol correspondence and emphasizes visual learning (a sight word approach); (b) that, a method to help these students acquire this ability be developed; or (c) both.

5. A final implication of this study is that as the phoneme-grapheme correspondence is taught, a formative evaluation of student learning be conducted so that if
paired-associational learning rather than concept learning occurs, it is detected. A good indication that the inappropriate paired-associational learning is occurring might be length of time of instruction. Paired association of the 19 consonant phonemes and numerous cases of each one could be expected to take considerably longer than if concept learning is occurring.  

**Recommendations**

1. Further research is indicated to better understand the dimensions of the ability to segment speech into the phonemic unit. The relationship of this ability to auditory memory and intelligence should be investigated. The ability of the young child to work with words pictorially represented versus words that are not pictorially represented should also be explored.

2. It is suggested that a further refined hierarchy of easy-to-difficult test tasks would include (a) a test of actual words in a picture match-to-sample situation using nouns (with three choices being offered rather than two so that chance level is reduced), (b) a test of actual words in a picture match-to-sample using verbs, (c) a test of actual words requiring a "same-different" judgment using nouns, (d) a test of actual words requiring a "same-different" judgment using verbs, and (e) a test of synthetic words requiring a "same-different" judgment.
3. Much experimentation is indicated to determine if students can be helped to develop this ability. The work of Williams (1980) with older learning-disabled students would seem to be applicable to younger students who are unable to segment the speech stream into phonemic units.

4. A determination of the etiology of the problem experienced by low-socioeconomic group students might give indication as to how to develop this ability.

5. A pilot study indicated that the distinctive features of the individual phonemes had no apparent effect on segmentation ability of subjects. However, future research could further investigate if, for example, the continuants are more easily segmented by students than are the plosives, etc.

Limitation

The requirement that parental permission be obtained influenced the composition of the sample. As might be expected, parents from the high-socioeconomic group returned permission letters in greater numbers than did parents from the low-socioeconomic group. Also, the older students in both socioeconomic groups were better able to remember to return the letters of permission. Thus, the findings of the study must be viewed with the knowledge that a number of subjects chosen by the randomization process, who probably had less parental support, interest, etc., were screened out of the study by the letter of permission requirement.
Summary

One of the first skills a beginning reader learns is the beginning consonant, phoneme-grapheme correspondence. Recent research has indicated that a barrier to this acquisition may be the inability of young children to segment the speech stream into phonemic units for the purpose of analysis. This segmentation task is difficult because the beginning consonant sound is folded into the vowel which follows it at the psychoacoustic level. Thus, words are not composed of a simple sequence of phonemes, but units of sound composed of two or more phonemes.

Young children come to the beginning reading situation with great ability to use phonemic units. They are able to distinguish between words which differ in only one phoneme such as bat and hat, in both their own speech production and in their behavioral response to other's speech. It is when they are required to work with the phonemic unit outside the context of ongoing speech (as is necessitated in learning the sound-symbol relationship) that segmentation and analysis of phonemic units are required and that some aspect of the sound system appears inaccessible to reflection. Segmentation and analysis of phonemic units outside the context of ongoing speech appears to be an abstraction accomplished at a psychoacoustic level and to require a level of psychological maturity to accomplish.

The purpose of this study was to identify the beginning reader's ability to segment speech sound into phonemic units.
and his ability to make analysis (judgment as to "same" or "different" with regard to beginning consonant phonemes).

A cross-sectional descriptive method was selected so that development as might be observed in a longitudinal study could be examined. Using the criteria of high- or low-socioeconomic status and grade level (kindergarten through third grade), subjects were randomly selected for eight groups. These consisted of a high- and a low-socioeconomic group for each of the four grade levels.

An individual test consisting of three screening components and three test components was administered. The screening components assessed students' auditory acuity and their understanding of the concepts "same-different" with regard to sound and "beginning" with regard to sequence of sounds. The test components assessed the student's ability to perform segmentation and analysis of beginning consonant phonemes. These test components utilized a test of synthetic words requiring a "same-different" judgment, a test of actual words requiring a match-to-sample task, and a task which required deletion of a phoneme from a given word to form a new word.

The data were subjected to a Chi Square approximation of the Kruskal Wallis test to determine if a significant difference in the ability to segment speech sound into phonemic units existed between the two socioeconomic classes at each grade level.
Means and standard deviations were calculated in order to determine if a developmental-like trend existed so that the means of the kindergarten group < the means of the first-grade group < the means of the second-grade group < the means of the third-grade group.

A Pearson correlation coefficient was calculated to establish the relationship between this ability and achievement in reading.

Mastery was arbitrarily defined as a score of 80% or higher and percentages of students scoring mastery in each group were calculated.

Conclusions

The following conclusions were made:

1. The ability of students to segment speech into phonemic units can be measured.

2. Approximately 30% of students from low-socioeconomic groups do not possess this ability during the years of beginning reading acquisition.

3. The ability to segment speech into phonemic units appears to be a mastery learning task.

4. The presence of the ability to segment speech into phonemic units appears to result in concept development when the phoneme-grapheme correspondence is taught; lack of the ability appears to result in paired-associative learning when the phoneme-grapheme correspondence is taught.
5. The most appropriate test of the ability for younger children is a test involving actual words in the match-to-sample situation. The most appropriate test of the ability for older students should utilize a test of synthetic words requiring a "same-different" judgment.

6. The ability to segment speech into phonemic units is more highly correlated with achievement in reading as the demands of reading are increased.

7. The concepts of "same-different" with regard to sounds and "beginning" with regard to sequence of sounds are necessary prerequisites to the ability to perform segmentation and analysis of phonemic units.

Implications

The concepts of "same" and "different" with regard to sounds and "beginning" with regard to sequence of sounds must be assessed and taught, if necessary, before the ability to segment speech into phonemic units is assessed or before instruction in the phoneme-grapheme correspondence is initiated.

It is necessary to assess the student's ability to segment the speech stream into phonemic units and make analysis before instruction in the phoneme-grapheme correspondence can be initiated. Further, ability of second- and third-grade students may not validly be measured with a test of actual words.
Placement of the phoneme-grapheme correspondence instruction in the curriculum should be different for the groups with different ability. Not all first graders have this ability.

Students who are unable to perform the segmentation task should be instructed by (a) an approach to beginning reading that minimizes the importance of the sound-symbol correspondence and emphasizes visual learning (a sight word approach), (b) a method which helps these students acquire the ability, or (c) both. A formative evaluation of student learning should be conducted as the phoneme-grapheme correspondence is taught so that if paired-associational learning rather than concept learning occurs, it is detected.
APPENDIX A

PARENT PERMISSION REQUEST LETTER

To the parents of ________________________________,

I am interested in finding out about children's ability to hear sounds made by letters. This information should help teachers do a better job in teaching reading.

Dr. ___(principal's name)___ and the ___(school district)___ Learning Council have given permission for me to use the ___(name of the school)___ in this study.

Taking part in this study will benefit your child. It is very important that a student is able to demonstrate what he knows on a test. Taking part in this study will give your child fifteen minutes of individually guided practice in effective test-taking.

For your child to take part, you will need to sign the permission form below and have him return it to his teacher tomorrow.

Thank you for your help.

Sincerely,

Barbara Mathews

I give permission for my child, ________________________________ to take part in this study. I understand that the study will take about fifteen minutes from regular school time and that no names will be used.

__________________________
Parent's signature
Screening Component C: Administration of the Test
(Concept of "Beginning")

I AM GOING TO SAY THREE NUMERALS TO YOU.
LISTEN: THREE (pause) ONE (pause) FOUR. I SAID THE
NUMERAL THREE FIRST, AT THE BEGINNING. LISTEN AGAIN,
FIVE (pause) TWO (pause) ONE. I SAID THE NUMERAL FIVE
FIRST, AT THE BEGINNING.

1. LET'S SEE IF YOU CAN TELL WHICH NUMERAL I
SAY FIRST. LISTEN: FOUR (pause) ZERO (pause) TWO.
WHICH NUMERAL DID I SAY FIRST? Confirm or correct.

2. LET'S SEE IF YOU CAN TELL WHICH NUMERAL I
SAY FIRST THIS TIME, WHICH IS THE BEGINNING NUMERAL?
LISTEN: ONE (pause) FIVE (pause) ZERO. WHICH NUMERAL
DID I SAY AT THE BEGINNING? Confirm or correct.

3. TELL ME WHICH NUMERAL I SAY AT THE START OR
AT THE BEGINNING THIS TIME. LISTEN: TWO (pause) FIVE
(pause) THREE. Confirm or correct.
### Screening Component C: Score Sheet

(Concept of "Beginning")

Mark each item in the appropriate column as was instructed in Component B.

<table>
<thead>
<tr>
<th></th>
<th>Successful</th>
<th>Successful after training</th>
<th>Unsuccessful</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

---

Total errors

Total correct
Test Component E: Administration of the Test
(Match-to-Sample Picture Test)

Materials required: pencil and test booklet for each subject.

This test requires the subject to match-to-sample on the basis of beginning sound.

AT THE TOP OF THE PAGE YOU CAN SEE A PICTURE WITH A DARK BOX AROUND IT. UNDER IT ARE TWO OTHER PICTURES. I WANT YOU TO SEE IF YOU CAN TELL ME WHICH PICTURE BEGINS WITH THE SAME SOUND AS THE ONE IN THE TOP BOX. I'LL NAME THE PICTURES FOR YOU. LET'S DO SOME TOGETHER FOR PRACTICE.

The examiner may use the word "start" and the word "begin" interchangeably. The words "alike" and "same" may also be used interchangeably. The intent is that the child understands the task. At no time should the beginning sound be isolated from the rest of the word.

Practice 1: THE TOP PICTURE, THE ONE WITH THE BOX AROUND IT, IS A CUP. (Point to the cup.) THEN YOU CAN SEE A BED (point) AND A CAT (point). I WANT YOU TO POINT TO THE PICTURE THAT BEGINS LIKE CUP. If a correct response is given offer validation and say LET'S CIRCLE THE PICTURE OF THE CAT. If an incorrect response is given, say "NO, THE RIGHT ANSWER IS CAT. CAT AND UP BEGIN WITH THE SAME SOUND." Then circle the correct answer.

Practice 2: Follow the dialogue used in Practice 1 but use the words nose, needle and boot.

Practice 3: Follow the dialogue used in Practice 1 but use the words wagon, potato, and wig.

NOW I'D LIKE FOR YOU TO DO THE REST OF THEM WITHOUT MY HELP BUT I WILL TELL YOU THE NAMES OF THE PICTURES.
**Test Component E: Score Sheet**

("Match-to-Sample Picture Test")

Mark the appropriate column as was instructed in Component A.

<table>
<thead>
<tr>
<th>Practice 1</th>
<th>Successful</th>
<th>Successful after training</th>
<th>Unsuccessful</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practice 2</th>
<th>Successful</th>
<th>Successful after training</th>
<th>Unsuccessful</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Practice 3</th>
<th>Successful</th>
<th>Successful after training</th>
<th>Unsuccessful</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Score the actual test items with a 1 indicating a correct response.
Score the actual test items with a 0 indicating an incorrect response.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____

Total errors: ______
Total correct: ______
Percentage correct: ______


Bond, G. L., & Dykstra, R. The cooperative research program in first grade reading instruction. Reading Research Quarterly, 1967 (Summer), 5-142.


Richek, M. A. Readiness skills that predict initial word learning using two different methods of instruction. Reading Research Quarterly, 1977-78, 13, 200-222.


