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Phonetic Context and Articulation Ability

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PHONETIC CONTEXT AND ARTICULATION ABILITY

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CAROLE SCHNEIDER

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CHAPTER I

INTRODUCTION

Speech pathologists in the public school have often noted that the greatest portion of their case load is involved with functional articulation disorders. Powers (1971) estimated that between 75 and 80 percent of the speech defectives in the school population are those classified as functional articulation disorders. Approximately 80 percent of these articulation disorders include the /r/, /s/, /l/, /θ/ phonemes (SWRL, 1972). Speech therapy, consisting of 20 to 30 minutes, twice a week, must be efficient in terms of time and progress. However, speech pathologists often use a "trial and error" method in the beginning of therapy. They randomly choose words and syllables in varying positions to use as stimulus words for therapy. Valuable time is spent and wasted with this method. The need for a more systematic approach is evident.

It has been noted that children are not consistent in their misarticulations of a phoneme (Roe and Milisen, 1942; Sayler, 1949). Siegel, Winitz, and Conkey (1963) and Spriestersbach and Curtis (1951) have suggested that the inconsistencies found in a child's misarticulation of a phoneme may be due in part to the phonetic context in which it appears.

Identifying the phonetic contexts in which the child correctly produces his misarticulated phoneme would be of considerable benefit to his speech therapy. From these key phonetic contexts, correct production may be extended to his more difficult phonetic contexts. Time involved to correct the misarticulated phoneme on the "trial and error" basis may be significantly reduced with this more systematic approach. Thus greater efficiency in articulation therapy is achieved.

The phenomenon of phonetic contexts may be researched through the utilization of a deep test of articulation. Templin and Darley (1960) described a deep test of articulation as follows: "Such a test may be used in deciding whether a child needs speech correction, but more frequently it is used with children already identified as having articulatory problems to aid in prescribing the nature of speech correction. It provides a detailed information about a child's ability to produce a wide range of speech sounds in a variety of positions and phonetic contexts" (p. 1). Deep testing a particular phoneme should provide insight into the child's articulation problem in a variety of phonetic contexts. A child's consistency in misarticulation of a phoneme is examined in depth. Phonetic contexts may be considered in terms of singles (consonant-vowel combinations) and blends (consonant-consonant-vowel combinations). The consonant or vowel which precedes or follows the phoneme being tested has a physiological influence on the phoneme being tested in that context or syllable.

The syllable or context itself may be either accented or unaccented. Griffith and Miner (1973) provide a summary of the research on stress and its relevance in phonetic context testing.

> "Fry (1955) reports that vowels in stressed syllables have longer duration than unstressed syllables. Bollinger (1955) argues that intonation is crucial to stress identification. Mol and Uhlenbeck (1955-6) point out that the ear as an acoustic analyzer is particularly sensitive to differences in duration among syllables. A later study by Fry (1958) concludes that both duration and intensity have influence upon stress perception. Lieberman (1960) reports that stressed syllables have higher fundamental frequencies, higher peak envelope amplitudes and longer durations than unstressed syllables. Stetson (1951) concludes that stress production is the result of increased intrapulmonic pressure, a conclusion essentially supported by more recent electromyographic studies (Ladefoged, Draper and Whitteridge, 1958). Generally, muscle activity increases during the production of stressed syllables" (p. 10).

Griffith and Miner conclude that stress is a product of an overall energy increase in the entire phonatory mechanism. Therefore, phonetic context analysis should include syllabic stress as a parameter of measurement.

The traditional three position (initial, medial, final) testing procedure is rejected in this study since speech is a sequence of syllables. The medial position only occurs in written language. Stetson (1951) demonstrated that the syllable should be considered the basic phonetic unit in speech. He found that every syllable exists on a separate chest pulse (pressure); the pressure falls (decreases) between the syllable pulses. Thus, he has demonstrated the existence of syllable boundaries.

Syllable boundaries are further inhanced by the stress of the syllable. Griffith and Miner (previously cited) reported that stress results from an overall energy increase in the entire phonatory mechanism. A syllable boundary becomes defined not only by the separate chest pulses involved with the production of syllables, but also by differences in the stress of succeeding syllables.

According to Stetson, the vowel is the core of every syllable. The consonant releases or arrests the vowel. Thus, the consonant functions only within its syllable. Through the definitions of syllable boundaries and of the consonant's role within the syllable, only two testing positions are created; i.e., initial (pre-vocalic) and final (post-vocalic).

Keenan (1961) defined the 'medial position' as follows: "a phoneme is in a medial position in a word when it is neither the first or the last sound in that word" (p. 171). He condemned the medial position as vague and ambiguous. This criticism arose from the observation that the /d/ in 'candy,' 'today,' 'admire,' and 'woodpecker' are all typically classified (and tested) as medial. However, closer examination reveals that each one of these /d/'s is different from the others in phonetic context, in syllabic stress, or in the syllabic position. In 'candy,' the /d/ is the initial phoneme of an unaccented syllable. In 'today,' it is the initial phoneme of an accented syllable. In 'admire,' the /d/ terminates an unaccented syllable; and in 'woodpecker,' it terminates an accented syllable. With such obvious differences in phonetic events, how can a speech pathologist justify using one adjective (medial) to describe them all? Keenan supported the discarding of the 'initial, medial, final' framework and suggested replacing it with a classification based upon the consonant's relationship to its syllable.

Although McDonald (1964) developed a pre- and post-vocalic testing procedure for his deep test of articulation, his system of analysis has been deemed as unacceptable by this author. McDonald tests the blend /ps/ by combining two words--'cup' and 'sun.' The resulting compound noun, 'cupsun' is composed of two syllables. Stetson reported that the syllable is a single ballistic movement; it is impossible to have two stresses within one syllable. However, McDonald hypothetically tests /ps/ as within one syllable. Thomas (1958) indicated that in a compound noun the stress normally falls on the first element of the compound. Thus, the stress and syllable division for 'cupsun' would be 'cup/sun.' On this basis, McDonald has attempted to test one syllabic unit with two different stress environments. He has obviously crossed the syllable boundaries (as opposed to testing a phoneme within its syllable).

The author of this investigation concluded that the Griffith and Miner system of analysis best meets the requirements of the research previously cited. Their analysis of a phoneme functions within a single syllable. Thus, phonetic context, syllabic stress, and the releasing or arresting feature of a phoneme are all considered.

A deep test of articulation which accounted for all possible combinations of contexts would indeed become very lengthy. For the purpose of testing these phonetic contexts in relationship to articulation ability, such a lengthy test may not prove worthwhile. Random selection of the phonetic contexts to be tested may shorten the length of a deep test of articulation, but the validity of the test itself may be questionable. Many important phonetic contexts could be omitted by using this method of selection.

How then, can a researcher develop a deep test of articulation that is of reasonable length and still maintains validity? Perhaps, this question may be answered by examining the importance of the phonetic contexts. We need to determine a basis for the testing of one phonetic context over another phonetic context. McDonald (1964, p. 54) has indicated some requirements for a deep test of articulation: "...need exists for a rather detailed testing of any defective sound <u>in all phonetic contexts in which it normally occurs for the subject being tested</u>..." (underscores added). According to this statement, phonetic context importance may be determined by those contexts which normally occur (or most frequently occur) in a child's language. Testing the most frequently occurring phonetic contexts in a child's language is more desirable than a random selection of contexts. The most frequently occurring phonetic contexts carry the weight of communication. Since certain contexts are spoken more often by the child, they are subsequently heard more often by the listener. The misarticulation of any of these most commonly occurring phonetic contexts leads the listener to perceive a speech defective child. Deep testing the most frequently occurring phonetic contexts enables the clinician to determine which defective phonetic contexts are drawing attention to the child's speech. She is also able to determine a basis for articulation therapy by using stimulus words containing these defective phonetic contexts which are occurring most frequently in the child's language.

The determination of the most frequently occurring phonetic contexts in a child's language may be justified by Zipf's Law (Zipf, 1935): there is an inverse relationship between word frequency and its length. A shorter word occurs more frequently in language than a longer word. For example, the short word "gas" is used more often than the longer version "gasoline." Using Zipf's Law, a rank ordering of word frequency is obtained. The assumption may be made that phonetic contexts likewise rank order themselves according to frequency of occurrence. Griffith and Miner (1973) have examined the relationship between Zipf's Law and phonetic context occurrence. Using the first 1000 words of the Thorndike-Lorge 10,000 most frequently occurring words, they analyzed the words according to a number of stimulus parameters, one of which was phonetic context. Griffith and Miner found that phonetic contexts do rank order themselves according to frequency of occurrence.

Griffith and Miner's study partially fulfills the requirements for a deep test of articulation set forth by McDonald (previously cited). They have provided a basis for constructing a deep test of articulation which utilizes the most frequently occurring phonetic contexts in a child's language. However, the resultant rank ordering of phonetic contexts obtained by them are based upon first and second grade word lists. McDonald indicated that the phonetic contexts in a deep test of articulation be those which <u>normally occur for the child being tested</u>. Would a deep test of articulation constructed from first and second grade children's most commonly occurring phonetic contexts validly test the most frequently occurring phonetic contexts in children beyond the second grade? To answer this question, Dorn (1973) and Schneider (1973) analyzed the Thorndike-Lorge third and fourth grade list of the most frequently occurring words for /r/ and /s,l/ respectively. The phonetic context frequency of occurrence in third and fourth grade children was analyzed in a manner identical to that of Griffith and Miner's study for first and second grade children. The resultant rank ordering of phonetic contexts was then compared to Griffith and Miner's data. No statistically significant differences in phonetic context frequency of occurrence were found between first and second grade children and third and fourth grade children for the /r/, /s/, /l/ phonemes. Although certain contexts were added in the third and fourth grade lists, these contexts were sufficiently low in frequency of occurrence to warrant their omission when testing third and fourth grade children. The majority of these additions were attributed to unaccented phonetic contests. The influence of these unaccented contexts on children beyond fourth grade remains questionable. However, a deep test of articulation based on Griffith and Miner's data for first and second grade children would seem to validly test third and fourth grade children. The stability of the phonetic context rank orderings between these two groups of children supports the hypothesis that similar phonetic context frequency of occurrence would be obtained for children beyond fourth grade. Tables denoting the relationship between first and second and third and fourth grade children's phonetic context rank ordering of frequency of occurrence for /r/, /s/, /l/ may be found in the Appendix.

Griffith and Miner (1973) give some considerations for the utilization of phonetic context rank order information. "First, it is possible for the clinician to administer "deep" testing of articulation with a controlled vocabulary suitable to a range of ages...Second, such lists enable the clinician to test articulatory proficiency in phonetic contexts that are proportional to the frequency of usage in actual language...Third, word frequency-phonetic context lists permit the clinician to select stimulus words that possess the phonemic, grammatic, and prosodic features required by the learning task."

Although the importance of deep testing with phonetic contexts is generally recognized, there is a need for more detailed information about the phenomenon of phonetic context in relationship to articulation ability. This investigation examined certain relationships between phonetic context and articulation ability by utilizing a deep test of articulation based upon the commonly occurring phonetic contexts in a child's language for /r/, /s/, /l/ in both singles and blends.

Statement of Purpose

The purpose of this investigation was to construct a deep test of articulation for the phonemes /r/, /s/, and /l/ and to administer this test to a sample of public school children with functional articulation disorders involving these phonemes. From the data obtained, analyses were made concerning the relationship between phonetic context and articulation ability.

The relevant questions asked in this study were as follows:

1. What is the resulting rank order of frequency of occurrence for correct production for /r/, /s/, and /l/ in singles and blends as a function of (a) all phonetic contexts, and (b) syllabic stress?
2. To what extent do the correctly produced phonetic contexts for /r/, /s/, and /l/ rank order themselves in a manner similar to their frequency of occurrence in the English language?

3. Do statistically significant differences exist between males and females for the mean number of correct productions?

4. Do statistically significant differences exist between singles and blends for the mean percentage of correct productions?

5. What is the distribution shape of correct production scores for each phoneme /r/ and /s/?

CHAPTER II

REVIEW OF LITERATURE

Speech Defectives in School Population

The importance of developing better approaches to articulation therapy with functional disorders may be viewed as proportional to its high incidence in the public schools. Root (1926) conducted a study of the speech defectives in the public elementary schools of South Dakota. He found that 60 percent of this population were articulatory defective. Loutitt and Halls (1936) found the articulatory defectives to comprise 79 percent of the speech disorders in their school population. Reid (1947) estimated the functional articulation disorders to be at least 50 percent of the total speech defective school population. Bingham, Van Hattum, Faulk, and Taussig (1961), using a nationwide sample of speech clinicians, found 81 percent of the caseloads involved functional articulation disorders. Finally, Powers (1971) upheld the high incidence of functional articulation disorders in the school population by reporting 75 to 80 percent of all speech defectives to be this type.

The utilization of the /r/, /s/, /l/ phonemes in this study was also justified by high incidence. Carrel (1937) found the /r/, /s/, /l/

phonemes to be commonly defective among school children. The Southwest Regional Laboratory for Educational Research and Development (1973) surveyed 949 speech clinics in the United States. It was reported that 80 percent of the caseloads in these clinics were accounted for by the /r/, /s/, /l/, /θ/ phoneme articulation problems.

Spontaneous versus Imitation Testing

Typically, articulation testing is accomplished through the presentation of stimulus pictures in order to elicit a spontaneous response. Due to the difficulty in protraying some phonemes to be tested, various articulation tests allow these words to be evaluated through imitation. Spontaneous testing enables the speech therapist to evaluate a child's typical production of phonemes. Imitation testing enables the speech therapist to evaluate the child's production after stimulation of the correct form. Considerable controversy has resulted from the question of whether imitation testing will elicit different responses than will spontaneous testing.

Snow and Milisen (1954) tested 81 defective speaking first and second grade children using a picture articulation test and an imitation test. They concluded that sounds which are produced better in an oral test are the ones which will show the most spontaneous improvement in articulation. In a second article by Snow and Milisen (1954) 114 defective speaking children performed consistently better to the imitative test rather than the picture articulation test. However, the individual difference scores between the two methods were small. Carter and Buck (1958) and Smith and Ainsworth (1967) also obtained similar results showing imitation testing to produce fewer errors in articulation ability than spontaneous testing.

Siegel, Winitz, and Conkey (1963) experimented with 100 subjects, giving them a 40 item picture articulation test and a 40 item imitation test. Eight of the 40 sound items produced significantly better results on the imitative articulation test. Eighty percent of the items were not observed to produce significant differences between the two modes of stimulus presentation. Further, Siegel, et al., suggest that the differences between the two tests are quite small in magnitude; and it would be practical to ignore them. It should be noted that the Chi-square and phi coefficients were used in the statistical analyses, indicating lower levels of measurement.

Templin (1947) tested spontaneous versus imitation testing in 100 preschool children. She concluded that there were no significant differences between the two methods of articulation testing. Ham (1958) found similar results when he concluded that the mode of presentation (pictorial or oral) had no significant relationship to the frequency of articulation errors.

Scott and Milisen (1954) tested 64 speech defective children to measure the effects of visual, auditory, and auditory-visual stimulation. They concluded that the combined auditory-visual method was apt to produce better results (fewer errors) in an imitation articulation test. The auditory method alone ranked second. Humphrey and Milisen (1954) obtained similar results using unfamiliar sounds. Visual plus auditory cues produced significantly better results. Smith and Ainsworth (1967) suggest that the combined auditory-visual method elicits more correct responses than either the auditory or visual method alone.

It would appear from this research that the controversy involving spontaneous versus imitation testing is not solved. However, the weight of the research tends to lead speech clinicians to the conclusion that imitation testing may produce fewer incorrect responses than spontaneous testing. If a speech pathologist desires to know a child's typical articulation performance, a spontaneous test may be used. However, if for purposes of planning an effective therapy program, the speech pathologist desires to know the child's capability or stimulability for certain speech sounds (phonetic contexts), an imitation test would give these results. The combined auditory-visual method of stimulation would be most desirable for this purpose.

Phonetic Context

The inconsistencies of a child's misarticulations have been noted by several researchers. Roe and Milisen (1942) and Sayler (1949) noted that certain blends were produced correctly more often than were their single phonemes. Spriestersbach and Curtis (1951) reviewed the Iowa studies and cite Amidon (1941) as finding only 36.5 percent of the articulation errors observed in the responses of a given child occur in all three positions of the words tested. However, this data was accumulated for blends only. Since children do not consistently misarticulate a given phoneme, it must be assumed that there are variables operating to influence his production. The Iowa studies were designed to identify these variables. Nelsen (1945) studied the misarticulation of /s/ in varying phonetic contexts as singles and blends. His results indicated that 46.6 percent of the children did not produce the /s/ in any phonetic context. The results of Hale (1948) and Buck (1948) seemed to indicate that the children who correctly produced a typically misarticulated phoneme were more aware of the phonetic entity of the phoneme. Spriestersbach and Curtis summarized the research by suggesting that individuals misarticulate sounds inconsistently on a lawful basis. This basis is, in part, a function of the phonetic context in which the sound occurs.

Curtis and Hardy (1959) investigated the consistency of misarticulations of the /r/ phoneme. The results showed differences in response patterns among the varying phonetic contexts, among certain subclasses of /ɚ/ and /ɝ/, and among different consonant /r/'s. They attributed the inconsistency of functional misarticulations to a certain extent to the phonetic context in which the /r/ occurs. They further suggested that a rather thorough phonetic analysis of articulatory defective speech may be valuable in understanding the problems and planning of a corrective program. Thus, the phonetic contexts which facilitate correct articulation for the individual case may be revealed.

Siegel, Winitz, and Conkey (1963) found intra-subject variability consistent with the previous researchers. They likewise attributed this variability in misarticulations to the phonetic context in part. They suggested further research in this area.

Leonard and Ritterman (1971) provided supportive research for this investigation by examining frequency of occurrence effects on the production of /s/. The stimuli consisted of monosyllabic words classified as follows: low and high frequency words in which were low or high frequency /s/ clusters. The stimulus words were tested on an imitative basis. Significant differences were found between high and low cluster frequency performances and between high and low word frequency performances for the /s/ defective subjects. Further analysis revealed significant differences between the following permutations: (1) low cluster/low word and high cluster/low word, (2) low cluster/low word and high cluster/high word, (3) low cluster/high word and high cluster/low word, (4) low cluster/high word and high cluster/high word frequency. No significant difference was observed between initial-cluster and final-cluster performances. In general, they found that the higher the cluster frequency, the lower the number of articulation errors. They concluded that the inconsistencies of /s/ production appear to be related to the frequency with which the /s/ clusters occur. A question concerning present day articulation testing was raised: "Our results suggest that most articulation testing of /s/ clusters may be making an unwarranted assumption that the stimuli used to evoke responses adequately sample a child's articulatory abilities regarding cluster /s/ productions in words" (p. 484).

Zehel, Shelton, and Arndt (1972) studied the effects of immediate and broad contexts upon /s/ production in 14 speech defective children. Broad and immediate contexts were defined as: "Given ayxzb, x is the speech sound of interest, y and z are the immediate contextual environment, and a and b are parts of the broader contextual environment" (p. 852). They found that broad contexts had little influence on the articulation of /s/. In contrast, immediate contexts were more important. Zehel, et al., concluded as follows: "Subjects produced significantly more satisfactory /s/ phones in some immediate contexts than in others. However, it is difficult to generalize from these data to treatment of the inidividual...

We would also conjecture that for many children, especially those who easily modify their articulations in response to stimulation, context is relatively unimportant in articulation remediation...information about context as a factor in articulation remediation could be gathered as a side benefit" (p. 858). This reduction of phonetic context importance to a "side benefit" has not been substantiated by previous researchers. Perhaps, Zehel's, et al., conclusions are a function of the testing instrument used in their study, i.e., the McDonald Deep Test of Articulation and the modifications of it. Questions have been raised concerning the validity of this test (Griffith and Miner, 1973; and Garrett and Peterson, 1972).

Gresch and Payne (1973) studied the hypothesis that /r/ phonemes develop systematically through a series of phonetic contexts. The McDonald Deep Test of Articulation was utilized to test 283 children who ranged in age from three to eight years. The results showed that the mean errors per age group decreased as age increased. This difference in means was significant beyond the .001 level. (Authors did not state which means were compared; i.e., each pair of means or the means in general.) A significant difference at the .01 level was found in the frequency of errors across the contexts. However, the authors did not state whether the significant difference existed between each pair of contexts or if it occurred among the contexts in general. It is doubtful that the difference existed between each pair of contexts. Rank ordering of the contexts according to the frequency of errors revealed that /rs/, /rθ/, and /rz/ were the most facilitating contexts to correct /r/ production (fewer errors) and /ɔr/, /mr/, and /lr/ were the least facilitating in /r/ production. The high frequency of errors for /ɔr/ may be explained by the tendency of /ɔ/'s lip rounding to inhibit correct production of /r/. The high frequency of errors for /mr/ and /lr/ may be a function of McDonald's system of analysis. Only in his system do such contexts occur. Therefore, these contexts are not readily available to a child for discrimination and practice. Of the contexts tested, a vowel-/r/-consonant combination was found to have less errors over the total population than a consonant-/r/-vowel combination. This would indicate that final blend contexts were more facilitating to correct /r/ production.

In McDonald's book Articulation Testing and Treatment: A Sensory-Motor Approach (1964), the following points are summarized:

"1) individuals who misarticulate the speech sounds typically do so inconsistently;
2) the inconsistencies are to be accounted for on a lawful basis;
3) need exists for a rather detailed testing of any defective sound in all phonetic contexts in which it normally occurs for the subject to be tested;
4) from the clinical point of view, to look for phonetic contexts in which the individual consistently articulates the sound correctly is feasible and advisable;
5) during early stages of retraining, the routine use for all subjects of words in which the sound occurs as a single is to be questioned. Rather, articulation of blends may facilitate generalized improvement;
6) ear training adapted to the particular phonetic contexts in which the individual's misarticulations occur is probably more effective than the gross type now commonly employed;

7) a longer period of ear training may be necessary for eradicating certain types of articulation errors than for others" (p. 54).

McDonald further suggests that careful, detailed testing, systematically exploited, may well provide cues to significant short-cuts in therapy.

McDonald Deep Test of Articulation

McDonald (1964) opened the doors to phonetic context testing in articulation. He developed A Deep Test of Articulation using pictures as stimulus items. Combinations of 25 consonants and 10 vowels are examined in depth in this test. It was constructed to test a sound as preceded by each of the other sounds and followed by a vowel, and as followed by each of the other sounds and preceded by a vowel. Therefore, overlapping, ballistic articulatory movements on the production of a sound are studied. Stimuli are formed by combining two words into one test word, i.e., 'cup' and 'sun' become 'cupsun.' The context /ps/ is tested. Garrett (1972) questions the validity of this testing procedure: "McDonald's contention that a two-syllable utterance is an adequate sample of 'connected speech' is, however, open to question" (p. 951). The influence of syllabic stress in these two-syllable words may inadvertently change the testing environment of the items. Griffith and Miner (1973) have found that McDonald's deep test lists only 8 of the 55 /s/ and 8 of the 46 /r/ phonetic contexts which most frequently occurred in the former's study. The two studies may not be comparable as Griffith and Miner made a more extensive analysis by including syllabic stress as a feature of phonetic context. Peterson (1972) further criticizes the McDonald deep test: "If there were comparative data, in terms of percentage of expected correct responses for an age or in terms of rank ordering of the difficulty of contexts in which the sounds are to be tested, this would greatly enhance the value of the Deep Test and provide more general diagnostic and prognostic information for the clinician" (p. 952). McDonald's Deep Test of Articulation was a start in the right direction; however, its short-comings have been observed. Need exists for a deep test of articulation which has greater validity.

Griffith and Miner Study

Griffith and Miner (1973) studied the relationship between Zipf's Law and phonetic context. They suggest that when selecting words for articulation therapy, both phonetic context and word frequency must be controlled. Therefore, a child's ability to master the major phonetic contexts for the frequently occurring words should lead to greater communicative success. Griffith and Miner analyzed the first 1000 words of the Thorndike-Lorge 10,000 most frequently occurring words. These 1000 words represent the basic vocabulary of first and second grade children. Phonetic contexts were analyzed in both consonant singles and blends. Pre-vocalic and post-vocalic positions were considered in terms of accented and unaccented syllables. The following results were found for the /r/, /s/, and /l/ phonemes: 1) total number of words in vowel and blend environments - 259 /s/, 269 /r/, and 190 /l/; 2) nearly all of the /r/, /s/, and /l/ words were one or two syllables (Zipf's Law); 3) /r/ occurrence - 24 different vowel and 22 different consonant blend contexts; 4) /s/ occurrence - 32 different vowel and 23 different consonant blend contexts; 5) /l/ occurrence - 34 different vowel and 18 different consonant blend contexts.

Tables 17, 18, and 19 in Appendix I represent the phonetic contexts for /r/, /s/, and /l/ which were found to most frequently occur in singles and blends with the syllabic stress as initial accented (I/A), initial unaccented (I/UA), final accented (F/A), and/or final unaccented (F/UA).

CHAPTER III

PROCEDURE

Selection of Subjects.--Children with functional articulation disorders of the /r/, /s/, and /l/ phonemes were included in this study. The following children who exhibited an articulation disorder were excluded: those with severe organic involvements, such as cleft palate or cerebral palsy; those who stutter; those with additional speech impairments such as voice disorders or a serious delay in language development. So as to include only children with normal intelligence, those in Educable Mentally Handicapped or exceptional ability classes were excluded. It was hypothesized that exclusion of these children would result in a population of public school children with "average" intelligence. All children were judged as having no observable hearing impairment by the speech pathologist and classroom teacher. Only children from monolingual homes were accepted.

The subjects were chosen from grades 1 through 8 in public schools included in the East Central Illinois Speech and Hearing Association. The children were selected by the speech pathologist of each school involved in the study by utilizing the previously mentioned criteria. The number of subjects (N) was set for 200. Following is a table displaying the public school systems involved in the study and the number of subjects each school contributed.

TABLE 1.--List of sources from which subjects were selected

Source		N
Altamont		29
Casey		13
Cerro Gordo		45
Decatur		54
Effingham		23
Nokomis		27
Paris		9
	Total	200

Table 2 displays the number of males (M) and females (F) at each grade level for each phoneme /r/, /s/, and /l/.

TABLE 2.--Grade and sex breakdown of subjects for /r/, /s/, and /l/

	/r/		/s/		/l/	
Grade	M	F	M	F	M	F
1	20	16	13	8	10	3
2	12	12	15	10	0	0
3	8	2	8	4	1	0
4	7	2	8	0	4	1
5	4	3	9	1	1	1
6	2	1	4	0	0	0
7	2	1	0	0	0	0
8	3	0	1	3	0	0
	58	37	58	26	16	5

Selection and Training of Examiners.--Five examiners were used in this investigation so that the results would not be limited to the judgment of the author. All examiners were graduate students in speech pathology with previous experience in articulation testing. The examiners were chosen by their willingness to cooperate in the study.

A meeting for all examiners was held prior to actual field testing for the following purposes: 1. to provide information concerning the justification of this study; 2. to explain administration of the deep test of articulation- (a) completion of subject information, (b) discussion of standardized instructions on the test (emphasis was given to having the child both listen to and watch the examiner as she presents each word for imitation, (c) scoring of the articulation test, (d) to establish interexaminer reliability. The examiners viewed a video tape of three children being administered a deep test of articulation for each phoneme /r/, /s/, and /l/. The author of this study had administered these tests while recording both audio and video stimuli. All examiners scored the children's responses and the data was examined for percentages of agreement. Interexaminer reliability resulted in 92 percent agreement for /l/, 91 percent agreement for /s/, and 87 percent agreement for /r/. These percentages of interexaminer agreement are acceptable when compared to other studies. Leonard and Ritterman (1971) reported interexaminer reliability of .85 for the /s/ phoneme. Curtis and Hardy (1959) reported interexaminer agreement of .87 for the /r/ phoneme.

Methodology.--An imitation test of articulation instead of a spontaneous test was chosen for construction since an imitation test more nearly parallels articulation therapy procedures. The inconsistency of a child's misarticulations is an important factor in a therapy program. More specifically, the rank ordering of the frequency of occurrence for correct productions of these phonetic contexts may prove to outline the therapy program. The stimulation method is commonly used in articulation therapy. The therapist gives the correct model and the child attempts to imitate her. Therefore, an imitation test would hypothetically give the rank ordering of the most stimulable to the least stimulable phonetic context for a given phoneme.

The phonetic contexts found to occur most commonly for the /r/, /s/, and /l/ phonemes in the Griffith and Miner (1973) study were used to construct this test. One word for each phonetic context was chosen from the Thorndike-Lorge list used in Griffith and Miner's study. One form was used for each phoneme. Arrangement of the test items on the forms was as follows: phoneme single plus vowel - initial position, accented/unaccented; final position, accented/unaccented; phoneme blends - initial position, accented/unaccented; final position, accented/unaccented. Test items under each category were listed according to the frequency of occurrence in language usage (Griffith and Miner). Both the phonetic context and stimulus word as well as a blank for scoring of a child's response was provided on the test form. Responses were to be judged as correct (+) or incorrect (-) productions of the phoneme tested. Substitutions, distortions, additions, or omissions were incorrect responses. A blank for the total raw score of correct productions followed the phoneme single and the phoneme blend subtest. A blank for the grand total of correct productions was located at the bottom of the test form.

Standardized instructions for the deep test of articulation were placed on each form. "I am going to say some words. Watch me and listen very carefully. After I say a word, you say it. Are you ready? Listen, say: ." It was not necessary for the examiner to repeat, "Listen, say" before each item. However, if the examiner noticed a lack of attention to both visual and auditory cues, she interjected the above phrase until complete subject attention was regained. Test items were repeated only once. Example test forms are included in Appendix II.

Statistical Analyses.--The questions posed in this investigation were answered according to the following procedures.

1. What is the resulting rank order of frequency of occurrence for correct production for /r/, /s/, and /l/ in singles and blends as a function of (a) all phonetic contexts, and (b) syllabic stress?

The number of correct productions for each phoneme /r/, /s/, and /l/ were tallied and computed into percentage of correct productions.

The percentages of correct responses to each consonant-vowel combination were then rank ordered from high to low. For example, there were 24 different /r/ plus vowel contexts. These contexts were rank ordered according to the context of highest correct production percentage to the context of lowest correct production percentage. In a like manner, the 22 /r/ blend combinations were rank ordered from high to low. Similar computations for /s/ and /l/ were made.

In addition, the percent frequency of correct productions for each phoneme were tallied as a function of syllabic stress. That is, for singles and blends, phonetic contexts were rank ordered from high to low within each of the following categories: initial-accented (I/A); initial-unaccented (I/UA); final-accented (F/A); and final-unaccented (F/UA).

2. To what extent do the correctly produced phonetic contexts for /r/, /s/, and /l/ rank order themselves in a manner similar to their frequency of occurrence in the English language?

The data obtained in question 1 was compared to the actual rank order frequency of occurrence for /r/, /s/, and /l/ in Griffith and Miner's (1973) research. All data was examined in the form of percentages. The magnitude of relationship between these two variables was computed by the Kendall Tau.

3. Do statistically significant differences exist between males and females for the mean number of correct productions?

A *t* test was computed to determine if significant differences existed between males and females in the mean number of correct productions for phonetic contexts in both /r/ and /s/. The phoneme /l/ was omitted from statistical analysis due to the small and uneven N in the male and female groups.

4. Do statistically significant differences exist between singles and blends for the mean percentage of correct productions?

A *t* test was computed to determine if significant differences existed between singles and blends for both /r/ and /s/. Raw scores for each subject were converted into percentages of correct productions. The mean percentage of correct productions was then computed for both singles and blends. The phoneme /l/ was omitted from statistical analysis due to a small N.

5. What is the distribution shape of correct production scores for each phoneme /r/ and /s/?

Measures of skewness and kurtosis were made for /r/ and /s/ under each of the conditions present in questions 3 and 4. Therefore, distribution shapes were obtained for males, females, singles and blends in regard to correct production scores.

CHAPTER IV

RESULTS AND DISCUSSION

Deep test of articulation scores were obtained for a population of 95 /r/, 84 /s/, and 21 /l/ articulation defective children. In order to meaningfully interpret these scores in answer to the questions posed at the outset of this investigation, statistical measures were applied. Test results were examined in terms of phonetic context rank order, relationships between these rank orders and the phonetic context rank order in English language, sex differences, phoneme combination differences, and distribution shapes. In this chapter, statistical analyses are reported and discussed.

Phonetic Context Rank Order

The tables on pages 32, 33, and 34 display the rank order of the phonetic contexts in singles and blends for /r/, /s/, and /l/ respectively. These contexts are rank ordered from high to low in relation to the percentage of correct productions for each context. The context's position (initial or final) and stress (accented or unaccented) are indicated in column 2.

TABLE 3.--Rank ordering of percentages of correct productions for /r/ single and blend contexts.

Singles			Blends		
Context	Type	%	Context	Type	%
or	F/A	59	pr	I/UA	86
rɑ	I/A	55	dr	I/UA	84
aIr	F/A	54	str	I/A	81
ɔr	F/A	53	tr	I/A	76
ɑr	F/A	53	dr	I/A	75
rI	I/A	52	rθ	F/A	67
rʌ	I/A	52	θr	I/A	61
re	I/A	46	gr	I/A	59
raI	I/A	46	rs	F/A	58
ær	F/A	43	rdʒ	F/A	58
ræ	I/A	40	rn	F/A	58
Ir	F/A	40	spr	I/A	54
rau	I/A	39	tr	I/UA	54
aur	F/A	39	rd	F/A	52
rɛ	I/A	38	rt	F/A	49
ɛr	F/A	35	br	I/A	47
rɔ	I/A	34	pr	I/A	46
rə	I/UA	29	rtʃ	F/A	45
ro	I/A	28	kr	I/A	44
rI	I/UA	26	rm	F/A	37
ur	F/A	26	rk	F/A	35
ro	I/UA	22	fr	I/A	28
ri	I/A	21			
ru	I/A	16			

TABLE 4.--Rank ordering of percentages of correct productions for /s/ single and blend contexts.

Singles			Blends		
Context	Type	%	Context	Type	%
si	I/A	64	st	I/A	85
sɛ	I/UA	64	nst	F/A	80
sʌ	I/A	62	st	F/A	76
sæ	I/A	61	st	F/UA	71
sau	I/A	60	sn	I/A	69
ɔIs	F/A	60	ns	F/A	69
sI	I/A	58	kst	F/A	68
æs	F/A	57	sk	F/A	67
saI	I/A	56	str	I/A	67
se	I/A	54	sm	I/A	63
ɛs	F/A	54	ts	F/A	58
is	F/A	52	sw	I/A	58
əs	F/UA	52	sp	I/A	57
sɔ	I/A	51	ks	F/A	57
so	I/A	50	sl	I/A	56
sə	I/UA	50	sk	I/A	52
Is	F/A	50	skw	I/A	51
Is	F/UA	50	spr	I/A	50
sɛ	I/A	49	rs	F/A	49
su	I/A	49	ns	F/UA	44
sɚ	I/UA	49	ls	F/A	43
aIs	F/A	49	spl	I/A	36
sɔI	I/A	48	ps	F/A	36
ʌs	F/A	48			
so	I/UA	46			
es	F/A	46			
sɝ	I/A	43			
ɑs	F/A	40			
aus	F/A	38			
ɔs	F/A	38			
os	F/A	37			
us	F/A	31			

TABLE 5.--Rank ordering of percentages of correct productions for /l/ in single and blend contexts.

Singles			Blends		
Context	Type	%	Context	Type	%
lɛ	I/A	90	fl	I/A	76
li	I/A	90	sl	I/A	76
lɝ	I/A	90	lk	F/A	76
lɔ	I/A	86	kl	I/A	71
laI	I/A	86	bl	I/A	71
lɑ	I/A	86	gl	I/A	71
lu	I/A	86	lp	F/A	71
lU	I/A	86	lvz	F/A	71
lə	I/UA	86	pl	I/A	67
le	I/A	81	spl	I/A	67
lʌ	I/A	81	lf	F/A	67
ʌl	F/A	81	gl	I/UA	62
lo	I/A	76	ls	F/A	62
læ	I/A	76	lv	F/A	57
lau	I/A	76	lθ	F/A	57
lI	I/A	71	bl	I/UA	43
əl	F/UA	71	lt	F/A	29
laI	I/UA	67	ld	F/A	10
ɑl	F/A	62			
ɛl	F/A	57			
ɔIl	F/A	57			
il	F/A	57			
Il	F/A	52			
lI	I/UA	48			
ul	F/A	43			
aIl	F/A	43			
Ul	F/A	43			
ɝl	F/A	43			
el	F/A	38			
ɔl	F/A	33			
æl	F/A	29			
ɔl	F/UA	19			
ol	F/A	10			

Table 3, displaying /r/ data, reveals that 86 percent of the 95 /r/ articulation defective children produced the blend context /pr/ correctly. The highest ranking single context /or/ was produced correctly in 59 percent of the children. In contrast, the lowest ranking (or most difficult) blend context was /fr/ with only 28 percent of the children producing it correctly. Only 16 percent correctly produced the single context /ru/. It is of interest to note that the blend contexts /pr/, /dr/, /str/, /tr/, /dr/, /rθ/, and /θr/ were all produced correctly more often than any single context. This may indicate that these blend contexts are more stimulable in children. Consequently, /r/ articulation therapy should be initiated with these blend contexts rather than a single context.

Table 4, displaying the /s/ data, reveals that the most stimulable blend context /st/ was produced correctly by 85 percent of the 84 /s/ articulation defective children. The highest ranking single contexts, /si/ and /sɛ/, were each produced correctly by 64 percent of the children. In contrast, the blend contexts, /spl/ and /ps/, were least stimulable with only 36 percent of the children producing them correctly. The single context /us/ was correctly produced by 31 percent of the children. As was noted in the /r/ data, certain blend contexts, /st/, /nst/, /st/, /st/, /sn/, /ns/, /kst/, /sk/, and /str/, were produced correctly more frequently than any single context. Again, this indicates that these blend contexts should be utilized to initiate /s/ articulation therapy.

Of further interest is the consistency of the highest ranking blend contexts. Six contexts were combinations of /st/; i.e., /st/, /nst/, /st/, /st/, /kst/, and /str/. Three contexts were combinations of /ns/; i.e., /nst/, /sn/, and /ns/. Two contexts were combinations of /ks/; i.e., /kst/ and /sk/. On this basis, a clinician could assume that it would be easier for an /s/ articulation defective child to achieve correct production with an /st/ word context.

Table 5, displaying the /l/ data, reveals that 90 percent of the 21 /l/ articulation defective children produced the single contexts /lɛ/, /li/, and /lɝ/ correctly. These three contexts would be most facilitating in /l/ articulation therapy. The highest ranking blend contexts were /fl/, /sl/, and /lk/, each produced correctly by 76 percent of the children. The least stimulable single and blend contexts were /ol/ and /ld/ which were responded to correctly by 10 percent of the children. The pattern of blend context initiation in therapy, reported for the phonemes /r/ and /s/, was reversed in the /l/ data. The single contexts /lɛ/, /li/, /lɝ/, /lɔ/, /laI/, /lɑ/, /lu/, /lU/, /lə/, /le, /lʌ/, and /ʌl/ were all produced correctly more frequently than any blend context. This reverse in pattern may be due to sampling error within a small N. Further analyses indicated that single contexts were correctly produced by 63 percent of the children and blends were correctly produced by 61 percent. These percentages indicate only a minimal difference between single and blend contexts.

In addition to the general rank ordering of phonetic contexts, /r/, /s/, and /l/ contexts were rank ordered as a function of syllabic stress. The tables on pages 38, 39, and 40 display the rank order of phonetic contexts for /r/, /s/, and /l/ respectively. These contexts are rank ordered from high to low in relation to the percentage of correct productions for each context. That is, the percentages are based on each context's frequency of correct productions within each stress category. For example, /rɑ/ attributed to 12 percent of the total correct productions in the I/A category. Tables 20, 21, and 22 in Appendix I rank order these contexts for /r/, /s/, and /l/ according to percentages based upon each context's frequency of correct productions in the total number of subjects. For example, /rʌ/ was correctly produced by 55 percent of the 95 /r/ articulation defective children. The data is presented two different ways for the reader's information. The rank orders of phonetic contexts do not change between the two sets of tables. This type of data helps to focus on phonetic context behavior as a function of the prosodic features of language. The phonetic context rank order information is useful to the clinician who organizes her therapy according to syllable position and stress. For example, if the clinician desires to create stimulus words of the initial position and accented nature for /r/ single contexts, /rɑ/, /rI/, and /r / would facilitate correct production. The context /ru/ would be least stimulable and therefore better left till the mastery of facilitating contexts has been accomplished.

TABLE 6.--Rank ordering of /r/ contexts in singles and blends according to percentages of correct productions within each stress category.

Singles						Blends					
I/A		I/UA		F/A		I/A		I/UA		F/A	
Context	%	Context	%	Context	%	Context	%	Context	%	Context	%
rɑ	12	rə	38	or	15	str	14	pr	38	rθ	15
rI	11	rI	34	aIr	13	tr	13	dr	38	rs	13
rʌ	11	ro	28	ɔr	13	dr	13	tr	24	rdʒ	13
re	10			ɑr	13	θr	11			rn	13
raI	10			ær	11	gr	10			rd	11
ræ	9			Ir	10	spr	9			rt	11
rau	8			aur	10	br	8			rtʃ	10
rɛ	8			ɛr	9	pr	8			rm	8
rɔ	7			ur	6	kr	8			rk	7
ro	6					fr	5				
ri	5										
ru	3										

TABLE 7.--Rank ordering of /s/ contexts in singles and blends according to percentages of correct productions within each stress category.

Singles								Blends					
I/A		I/UA		F/A		F/UA		I/A		F/A		F/UA	
Context	%	Context	%	Context	%	Context	%	Context	%	Context	%	Context	%
si	9	sɛ	31	ɔIs	10	əs	51	st	13	nst	13	st	62
sʌ	9	sə	24	æs	10	Is	49	sn	11	st	13	ns	38
sæ	9	sɚ	23	ɛs	9			str	10	ns	11		
sau	8	so	22	is	9			sm	10	kst	11		
sI	8			Is	8			sw	9	sk	11		
saI	8			aIs	8			sp	9	ts	10		
se	8			ʌs	8			sl	9	ks	9		
sɔ	7			es	8			sk	8	rs	8		
so	7			ɑs	7			skw	8	ls	7		
sɛ	7			ɔs	6			spr	8	ps	6		
su	7			aus	6			spl	6				
sɔI	7			os	6								
sɝ	6			us	5								

TABLE 8.--Rank ordering of /l/ contexts in singles and blends according to percentages of correct productions within each stress category.

Singles								Blends					
I/A		I/UA		F/A		F/UA		I/A		I/UA		F/A	
Context	%	Context	%	Context	%	Context	%	Context	%	Context	%	Context	%
lε	8	lə	43	ʌl	12	əl	79	fl	15	gl	59	lk	15
li	8	laI	33	ɑl	9	ɔl	21	sl	15	bl	41	lp	14
lɝ	8	lI	24	εl	9			kl	14			lvz	14
lɔ	7			ɔIl	9			bl	14			lf	13
laI	7			il	9			gl	14			ls	12
lɑ	7			Il	8			pl	13			lv	11
lu	7			ul	7			spl	13			lθ	11
lU	7			aIl	7							lt	6
le	7			Ul	7							ld	2
lʌ	7			ɝl	7								
lo	7			el	6								
læ	7			ɔl	5								
lau	7			æl	4								
lI	6			ol	1								

To determine if syllable position influenced the number of correct productions in /r/, /s/, or /l/ contexts, mean percentages of correct productions were computed for the initial and final contexts of each phoneme. Figure 1 displays this data. The position of the context did not influence the number of correct productions in /r/ and /s/ phonemes, i.e., initiating and terminating contexts were correctly produced in approximately equal percentages of the children tested. However, for the /l/ phoneme, contexts in the initial position were produced correctly more often than those in the final position (initial - 76 percent; final - 50 percent). For /l/ articulation defective children, therapy would be facilitated by phonetic contexts in the initial position of stimulus words. (As reported earlier, N was small and may have affected data by sampling error).

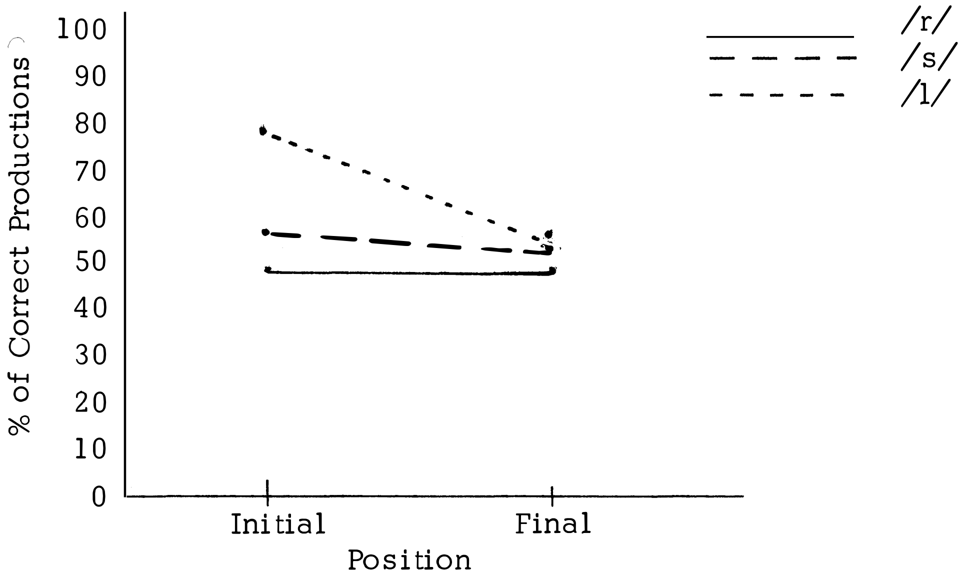

Figure 1.--Graph illustrating phoneme percentages of correct productions as determined by position.

The influence of syllabic stress on the number of correct productions was determined by computing mean percentages of correct productions for accented and unaccented syllables. Figure 2 displays this data for /r/, /s/, and /l/. Syllable stress did not greatly influence the number of correct productions for /r/ and /s/ contexts. Accented syllables were correctly produced more frequently than unaccented syllables for the /l/ phoneme. However, this difference was relatively small in magnitude (accented - 64 percent; unaccented - 56 percent).

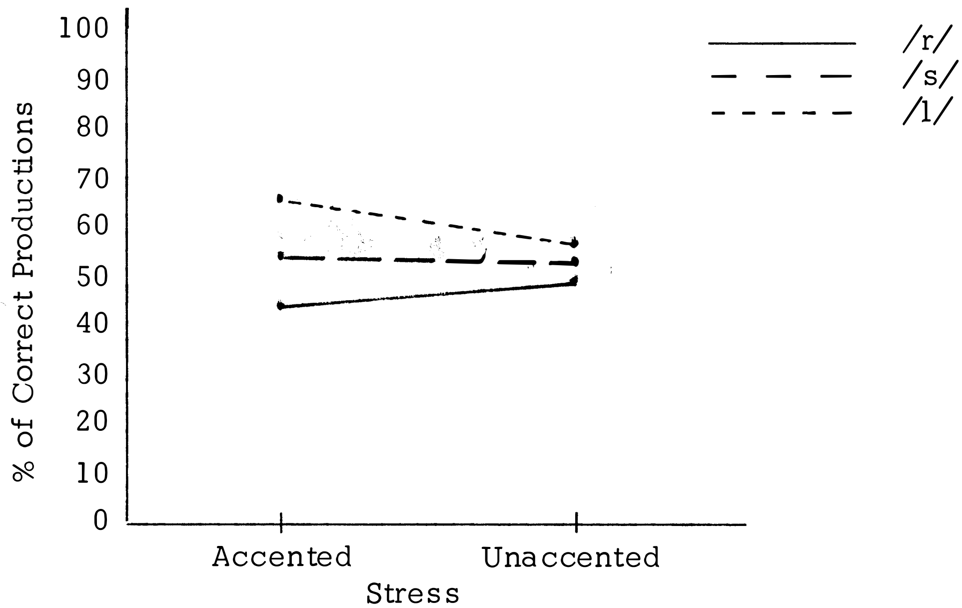

Figure 2.--Graph illustrating phoneme percentages of correct productions as determined by stress.

Although the general influence of position and stress was inconsequential for the /r/ and /s/ phonemes, an interaction effect was possible for these phonemes as well as for /l/. All possible combinations of position and stress in singles and blends were examined in terms of their mean percentage of correct productions. Figure 3 displays this data for the /r/, /s/, and /l/ phonemes. For the /s/ phoneme in single contexts, final/accented syllables were correctly produced less frequently than other combinations; however, the difference is minimal (8 percent maximum difference). /s/ blend combinations remained fairly stable in their percentages of correct productions. For the /r/ phoneme in single contexts, initial/unaccented syllables were correctly produced less frequently than other single combinations or blend combinations. In contrast, the blend initial/unaccented syllables were produced correctly more often than any other single of blend combination. The difference between two initial/unaccented combinations was 48 percent. For the /l/ phoneme in single contexts, both final/accented and final/unaccented syllables were produced correctly less frequently than initial position combinations. The initial/accented syllables were produced correctly more frequently in both single and blend contexts.

The data in these graphs indicate that neither position nor stress alone was responsible for the rank ordering of phonetic contexts in /r/ and /s/ phonemes. However, an interaction of these parameters was a greater determining factor of the rank ordering. A specific therapy procedure for children with defective /r/, /s/, or /l/ phonemes may be organized from this data. Stimulus words for therapy may be chosen in the following order (S-single; B-blend): /r/ - I/UA (B), I/A (B), F/A (B), F/A (S), I/A (S), and I/UA (S); /s/ - Blend combinations, Single combinations with F/A last; /l/ - I/A (S), I/A (B), I/UA (S), F/A (B), I/UA (B), F/A (S), and F/UA (S). Within each stimulus word category, contexts may be presented from the most stimulable to the least stimulable (Tables 6, 7, and 8).

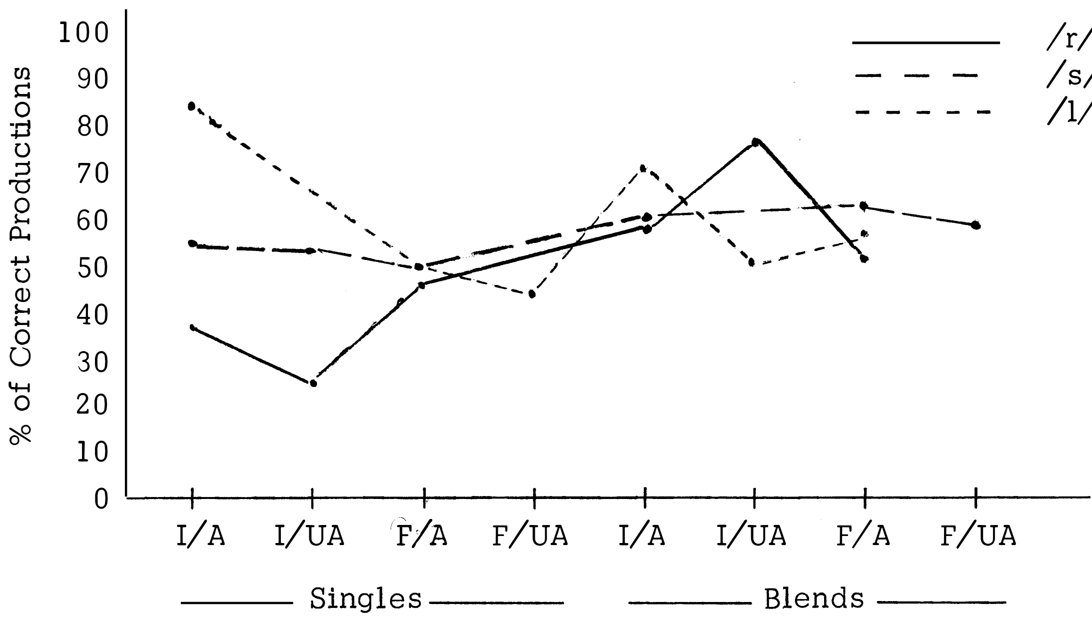

Figure 3.--Graph illustrating interaction effects of position and stress on percentages of correct productions.

The data obtained from the rank orders of phonetic contexts may be clinically utilized for the benefit of /r/, /s/, and /l/ articulation defective children. 1) A child's correct production of a defective phoneme may be facilitated initially by utilizing the most stimulable contexts in general (Tables 3, 4, and 5). 2) Stimulus word categories may be rank ordered for presentation by facilitation of correct production (Figure 3). 3) Correct production within each category may be facilitated by presenting the most stimulable contexts first (Tables 6, 7, and 8).

Correct Production Rank Order Versus English Language Rank Order

The relationship between the phonetic context rank order for correct productions and the rank order of these contexts in English language as determined by Griffith and Miner (1973) was computed by the Kendall Tau. The Kendall Tau is a non-parametric correlation statistic. It was chosen for this investigation, rather than the Spearman rho, as the Tau is a more conservative indicator of relationships between variables. That is, when comparing identical data, the Kendall Tau will typically give a lower estimate of the relationship than the Spearman rho. Tau's were determined between each category (I/A, I/UA, F/A, F/UA) for singles and blends in each phoneme /r/, /s/, and /l/. The resultant correlation values are displayed in Table 9.

In general, low correlations, either positive or negative, were found to exist between the two sets of data. Two perfect positive (1.00) and two perfect negative (-1.00) correlations existed. However, each of these phoneme categories was represented by only two contexts. Therefore, only minimal variability greatly affected the resultant Tau. The high correlations were a result of a small N.

TABLE 9.--Kendall Tau correlations for /r/, /s/, and /l/ phonetic context rank order between the frequency of correct productions and the frequency of occurrence in English language.

Type	Singles /r/	Singles /s/	Singles /l/	Blends /r/	Blends /s/	Blends /l/
I/A	-.08	.14	.00	-.02	.31	.24
I/UA	.33	.17	- .33	.00		1.00
F/A	-.11	.37	- .23	-.14	.24	- .36
F/UA		-1.00	1.00		-1.00	

These low correlations would suggest that the rank orders of correctly produced phonetic contexts were not related to the frequency of occurrence of these contexts in a child's language. The most frequently occurring phonetic contexts were not produced correctly more frequently nor were they the least correctly produced. The results of the Kendall Tau measurements uphold the hypothesis that the phonetic context rank orders may be attributed to the interactions of position and stress rather than to the frequency of occurrence of these contexts. The lack of result consistency with Leonard and Ritterman (1971) may be attributed to differences in the test stimuli. Leonard and Ritterman utilized stimulus words of high and low frequency of occurrence. The author of this present investigation utilized stimulus contexts of only the most frequently occurring words. Leonard and Ritterman chose their test stimuli on the basis of Roberts (1965) and Kucera and Francis (1967) American English word lists while this author chose words according to the Thorndike-Lorge word list.

Males Versus Females

The raw scores of correct productions for males and females were compared for differences in the /r/ and /s/ phonemes. Figure 4 displays the mean number of /r/ correct productions for males and females at each grade level

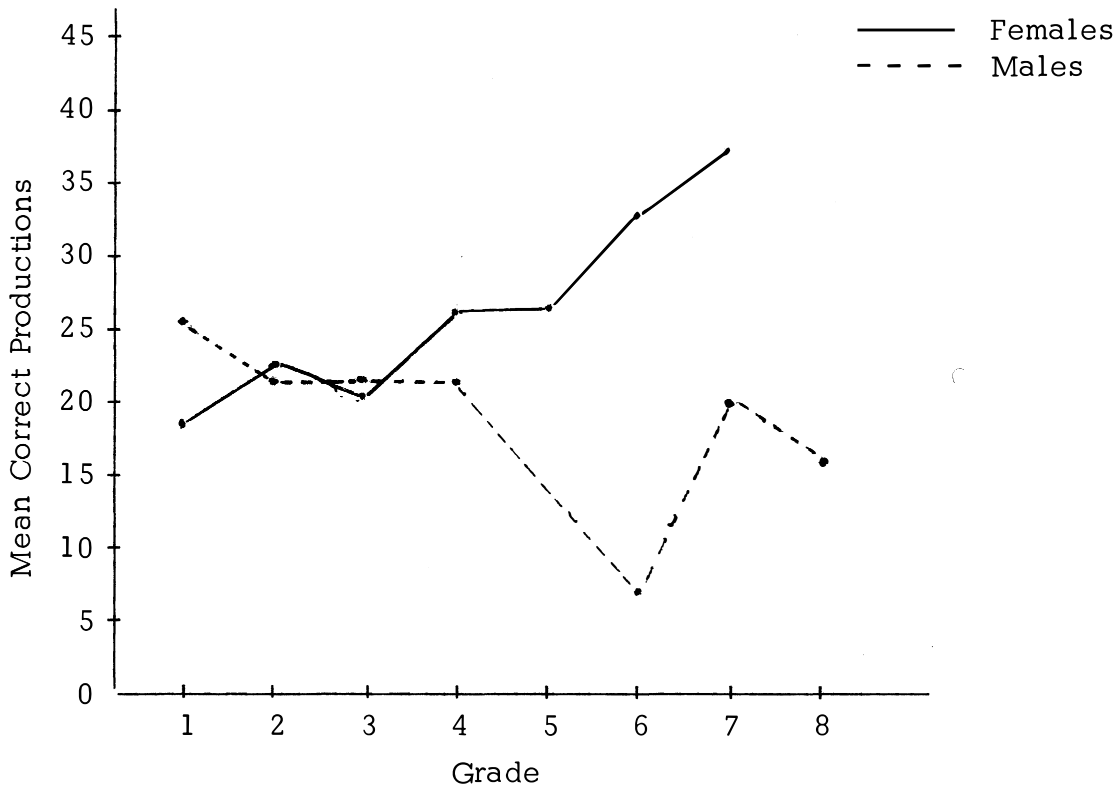

Figure 4.--Graph illustrating mean correct productions for /r/ as a function of sex.

Female mean correct productions were higher than males except at Grade 1. This reverse in trend for Grade 1 is consistent with the findings of Cairns, Cairns, and Blosser (1971). Greater differences in their means occurred in Grades 5 through 8. However, the number of subjects in these grades were small. Sampling error may have attributed significantly to the differences. It is of interest to note that female means increased as grade increased. This is supported by the results of Gresch and Payne (1973).

A t test was computed between the raw scores of the 58 male and 37 female correct productions. Grade level was not a factor. The resultant grand means were males, 21.9 and females, 22.5. The t value was -.2187, in favor of females. No significant difference existed between male and female correct productions at the .05 level.

Figure 5 displays the mean number of /s/ correct productions for males and females at each grade level.

Females consistently performed better than males with the exception of Grade 1. The general trend of increased mean correct productions as grade increased was again noted. The reverse in this pattern in Grade 8 may be due to sampling error and a small N. The t test, computed in an identical manner to /r/, resulted in no significant differences between males and females at the .05 level (t= -.1561, in favor of females). Grand means for the two groups were males = 29.5 (N = 58) and females = 30.0 (N = 26).

In general, for both /r/ and /s/, females tended to produce the phonetic contexts correctly more frequently than males. However, this difference between the sexes was not a statistically significant difference.

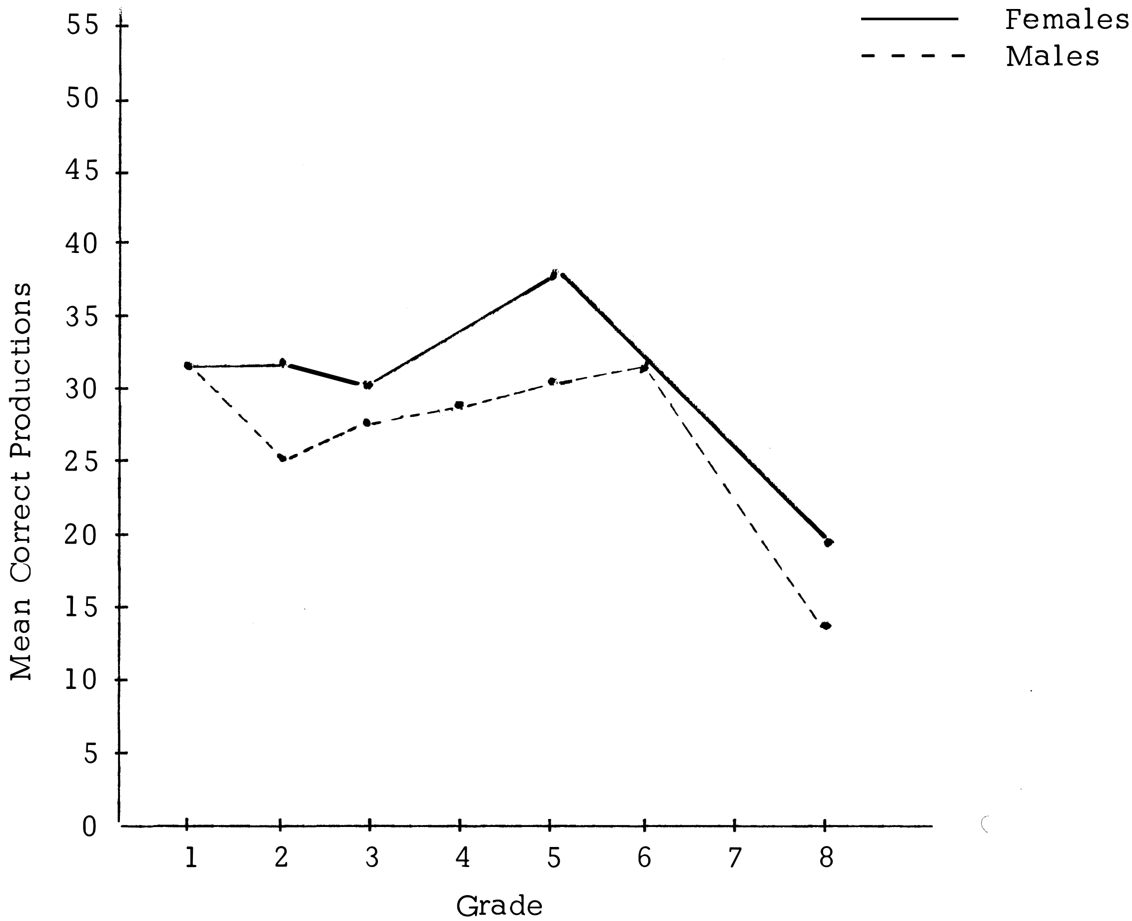

Figure 5.--Graph illustrating mean correct productions for /s/ as a function of sex.

Singles Versus Blends

The percentages of correct productions for singles and blends were compared for differences in the /r/ and /s/ phonemes. Figure 6 displays the mean percentage of /r/ correct productions for singles and blends at each grade level.

Blends were consistently produced correctly in a greater percentage of children than were singles. The Grand Mean of correct production

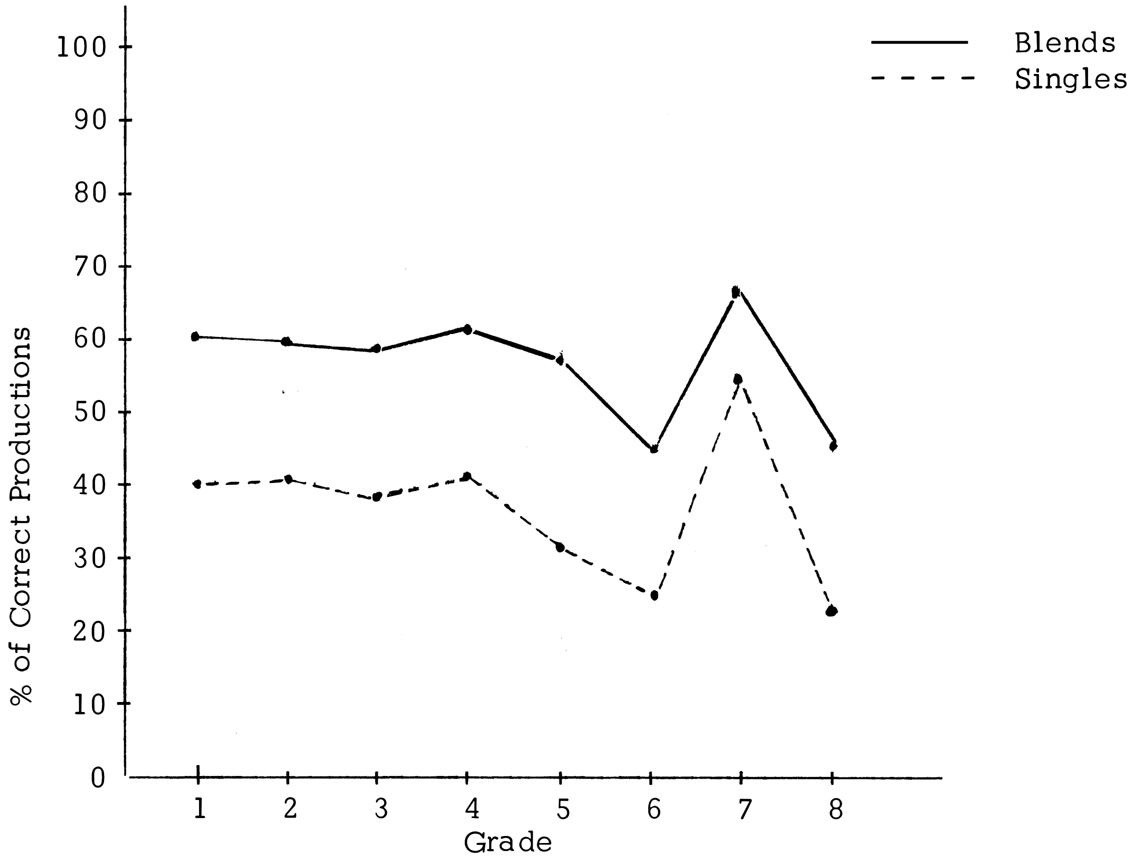

Figure 6.--Graph illustrating mean percentages of correct production for /r/ singles and blends.

percentages was 39.9 for single contexts and 57.3 for blend contexts. The t value for comparison of these two groups was -9.4505 (in favor of blends). This value indicated a statistically significant difference between single and blend combinations beyond the .0001 level.

Figure 7 displays the mean percentage of /s/ correct productions for singles and blends at each grade level.

As was found in the /r/ data, blends yielded consistently higher percentages of correct productions than singles. The Grand Mean of correct production percentages was 49.8 for single contexts and 59.1

for blend contexts. A statistically significant difference was obtained between single and blend combinations beyond the .0001 level (t = -4.5688, in favor of blends).

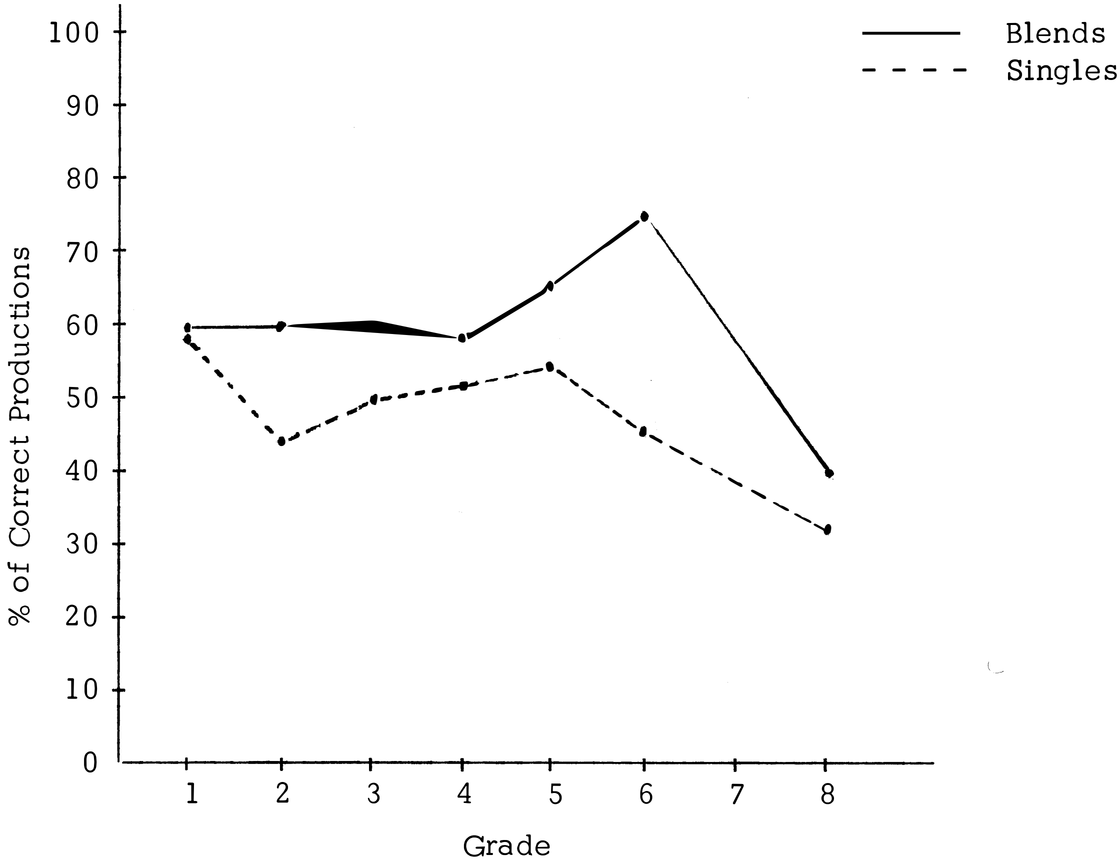

Figure 7.--Graph illustrating the mean percentage of correct productions for /s/ singles and blends.

In this investigation, blend contexts were significantly produced correctly in a greater percentage of the /r/ and /s/ articulation defective children than were single contexts. This is consistent with the results of previous researchers (Roe and Milisen, 1942; Sayler, 1949; Hale, 1948; and Buck, 1948). On the basis of this study, it is hypothesized that blend contexts may facilitate correct production in articulation therapy for the/r/ and /s/ phonemes. Speech Pathologists have typically aimed for correct production in single contexts before attempting correct production in blends. It is strongly suggested by this author that speech pathologists re-evaluate their therapy procedures. The mastery of blend contexts may generalize to correct production in some single contexts, as well as, facilitate correct production in others. Considerable progress in therapy may, therefore, result with the use of blend-single procedures as opposed to single-blend procedures.

Distribution Shape

The distribution shape of each subsample (males, females, singles, and blends) was determined for the /r/ and /s/ phonemes. Distribution shape provides an understanding of the overall performance of each subsample on the deep test. It is measured in terms of skewness and kurtosis. Skewness indicates the symmetry of the distribution. When the tail slopes to the right, the distribution is said to be positively skewed. The highest concentration of scores are, therefore, at the negative end of the distribution. Such a test would have its greatest power in identifying those gifted in articulation. A tail which slopes to the lower end or to the left is said to be negatively skewed. The higher concentration of scores are at the positive end of the distribution. A test's greatest power would be in identifying children who are severely articulatory defective. A value greater than $\pm$ 0.50 is indicative of considerable skewness.

Kurtosis indicates the peakedness of a distribution. A leptokurtic curve has its discrimination power at the extremes; thus it identifies slow and fast learners. The scores are concentrated around the mean. A mesokurtic curve refers to an essentially normal distribution of scores. When the distribution is flattened (i.e., height of curve is less than normal), it is said to be a platykurtic distribution. The scores are spread out from the mean. Its greatest discrimination is in the middle of the range. A value exceeding ± 0.50 indicates considerable peakedness.

Measures of skewness and kurtosis for the /r/ subsamples are displayed in Table 10. Interpretation of these values is consistent for all

TABLE 10.--Skewness, kurtosis, mean, and standard deviation values for /r/ males, females, singles and blends.

	Skewness	Kurtosis	Mean	SD
Males	.33	-1.03	21.9	11.3
Females	- .33	- .97	22.5	10.4
Singles	.31	-1.11	39.9	27.7
Blends	- .06	- .98	57.3	22.7

subsamples. Skewness values indicated that each /r/ subsample was normally symmetrical. Kurtosis values indicated that each /r/ subsample was a platykurtic or flattened distribution. Before discussing the clinical implications of these values, /s/ skewness and kurtosis measures will be reported. Table 11 displays these values for each /s/ subsample.

Skewness and kurtosis distributions for the /s/ subsamples were essentially identical to the /r/ subsamples. Skewness values indicated symmetrical distribution for each subsample with the exception of females. The value - .53 indicates minimal negative skewing for this group. Thus indicating there were fewer female subjects receiving low scores than male subjects. Kurtosis values for all subsamples again indicated a platykurtic or flattened distribution.

TABLE 11.--Skewness, kurtosis, mean, and standard deviation values for /s/ males, females, singles and blends.

	Skewness	Kurtosis	Mean	SD
Males	- .10	-1.00	29.5	12.6
Females	- .53	-1.12	30.0	14.4
Singles	- .15	-1.21	48.8	27.8
Blends	- .15	- .88	59.1	23.0

In general, for both /r/ and /s/, the skewness and kurtosis values indicated that each subsample was identical in distribution shape. All were essentially symmetrical platykurtic distributions (female /s/ sample differing slightly in symmetry). This has relevance to the differences observed in males and females, and singles and blends. Since the distribution shapes of /r/ and /s/ single and blend percentages of correct productions were identical, the significant differences between these two groups can be attributed to differences in central tendency. Although the differences observed between males and females for the /r/ and /s/ phonemes were not statistically significant differences, these existing differences can also be attributed to central tendency rather than differences in distribution shapes.

The symmetrical platykurtic curves obtained for the subsamples indicated the overall variability of the subjects' performance abilities. This factor further stresses the need for deep testing a child's defective phoneme as the results obtained for distribution characteristics clearly demonstrate the inconsistencies of children's responses. These inconsistencies are related to the phonetic context environments of the defective phoneme. The basis for this conclusion lies in the previously mentioned rank ordering of phonetic contexts and in the existing differences between single and blend contexts performance abilities. If children were not inconsistent in their responses, the phonetic context differences in number of correct productions (and thus the resulting rank order) would not have been obtained. Likewise, the observed difference between singles and blends would not have resulted. It is the hypothesis of this author that the inconsistencies in articulation ability were specifically the result of increased facilitation for correct production by certain phonetic contexts in the /r/, /s/, and /l/ phonemes.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this investigation was to construct a deep test of articulation for the phonemes /r/, /s/, and /l/ and to administer this test to a sample of public school children with functional articulation disorders involving these phonemes. From the data obtained, analyses were made concerning the relationship between phonetic context and articulation ability. Specifically, the following questions were posed at the outset of this study.

1. What is the resulting rank order of frequency of occurrence for correct production for /r/, /s/, and /l/ in singles and blends as a function of (a) all phonetic contexts, and (b) syllabic stress?

2. To what extent do the correctly produced phonetic contexts for /r/, /s/, and /l/ rank order themselves in a manner similar to their frequency of occurrence in the English language?

3. Do statistically significant differences exist between males and females for the mean number of correct productions?

4. Do statistically significant differences exist between singles and blends for the mean percentage of correct productions?

5. What is the distribution shape of correct production scores for each phoneme /r/ and /s/?

The deep test of articulation was administered to 200 children ranging in grade level from first through eighth. They were divided into three major subsamples thus creating a population of 95 /r/, 84 /s/, and 21 /l/ articulation defective children.

Phonetic contexts for /r/,/s/, and /l/ were rank ordered from high to low (greatest frequency of correct productions to lowest frequency of correct productions). The relationship between the rank orders of contexts frequency of correct productions and frequency in the English language was analyzed in terms of the Kendall Tau. Sex differences were assessed by means of the _t_ test. The _t_ test was also used to assess differences between types of phoneme combination (single versus blends). The distribution scores for sexes and phoneme combinations were described in terms of skewness and kurtosis.

Conclusions

The above statistical analyses concerning phonetic context and articulation ability were interpreted as follows:

1. Concerning the rank order of phonetic contexts
   a. Phonetic contexts do rank order themselves in terms of ease of production.
   b. For /r/, the single contexts /or/ (F/A), /rɑ / (I/A), and /aIr/ (F/A) were found to be most facilitating in correct production, while /ro/ (I/UA), /ri/ (I/A), and /ru/ (I/A) were found to be least facilitating.

c. For /r/, the blend contexts /pr/ (I/UA), /dr/ (I/UA), and /str/ (I/A) were found to be most facilitating in correct production, while /rm/ (F/A), /rk/ (F/A), and /fr/ (I/A) were found to be least facilitating.

d. For /s/, the single contexts /si/ (I/A), /sɛ/ (I/UA), and /sʌ/ (I/A) resulted in greater facilitation for correct production, while /ɔs/ (F/A), /os/ (F/A), and /us/ (F/A) resulted in the least facilitation.

e. For /s/, the blend contexts /st/ (I/A), /nst/ (F/A), and /st/ (F/A) resulted in greater facilitation for correct production, while /ls/ (F/A), /spl/ (I/A), and /ps/ (F/A) resulted in the least facilitation.

f. For /l/, the single contexts /lɛ/ (I/A), /li/ (I/A), and /lɝ/ (I/A) were found to be most facilitating for correct production, while /æl/ (F/A), /ɔl/ (F/UA), and /ol/ (F/A) were found to be least facilitating.

g. For /l/, the blend contexts /fl/ (I/A), /sl/ (I/A), and /lk/ (F/A) resulted in greater facilitation for correct production, while /bl/ (I/UA), /lt/ (F/A), and /ld/ (F/A) resulted in the least facilitation.

h. For both /r/ and /s/, the highest ranking blend contexts were all produced correctly more frequently than any single context, thus indicating the utilization of these blend contexts during the initiation of therapy.

i. For /l/, the highest ranking single contexts were more frequently produced correctly than any blend context.

j. The position (initial or final) of the context did not influence the number of correct productions in the /r/ and /s/ phonemes; i.e., initiating and terminating contexts were correctly produced in approximately equal percentages of the children tested.

k. For /l/, contexts in the initial position were produced correctly more often than those in the final position, thus indicating that therapy would be facilitated by phonetic contexts in the initial position of stimulus words.

l. Syllable stress (accented or unaccented) did not influence the number of correct productions for /r/ and /s/ contexts.

m. Accented syllables were correctly produced more frequently than unaccented syllables for the /l/ phoneme; however, this difference was relatively small in magnitude.

n. Although neither position nor stress was responsible for the rank ordering of phonetic contexts in /r/ and /s/ phonemes, an interaction of these parameters was a greater determining factor of the rank ordering.

2. Relationships between correct production and frequency of occurrence phonetic contexts rank order

    a. indicated that, in general, low correlations (either positive or negative) existed between the two sets of data.

    b. suggested that the rank orders of correctly produced phonetic contexts were not related to the frequency of occurrence of these contexts in a child's language.

    c. resulted in four high correlations which were attributed to small N (N = 2).

    d. upheld the hypothesis that interactions of position and stress were more important determining factors of the contexts' correct productions.

3. Concerning differences between males and females

    a. No statistically significant differences existed between male and female number of correct productions at the .05 level for both /r/ and /s/ phonemes.

    Graphic illustrations indicated that

    a. for /r/ and /s/, female mean correct productions at each grade level were higher than males with exception of Grade 1.

    b. in general, as grade increased so did the mean number of correct productions increase.

4. Concerning differences between singles and blends

   a. For /r/ and /s/, statistically significant differences existed between single and blend mean percentage of correct productions beyond the .0001 level.

   b. Blends contexts were produced correctly in a greater percentage of the /r/ and /s/ articulation defective children than were single contexts.

   c. It was hypothesized that blend contexts may facilitate correct production in articulation therapy for these phonemes as the mastery of blend contexts may generalize to correct production in single contexts.

   d. It was recommended that speech pathologists re-evaluate their traditional single-blend therapy procedures in favor of blend-single procedures.

5. Concerning distribution shapes of subsamples

   a. For both /r/ and /s/, skewness values indicated that each subsample (males, females, singles, blends) was normally symmetrical with the exception of /s/ females.

   b. /s/ females were found to have a slightly negative skewing.

   c. For both /r/ and /s/, kurtosis values indicated that each subsample was a platykurtic or flattened distribution.

d. The identical distribution shapes of each subsample indicated that the observed differences between males and females and that the statistically significant differences found between singles and blends were due to differences in central tendency rather than differences in distribution shapes.

e. The flattened distribution of the scores indicated great variability among the subjects in performance ability.

f. This supports the need for extensive deep testing of a child's defective phoneme since the results revealed that children are not consistent in their production of a phoneme.

Phonetic context and articulation ability are clearly related in that certain contexts facilitate correct production, whereas, other contexts tend to inhibit correct production. The value of deep tests of articulation has been substantiated in this investigation.

APPENDIX I

TABLE 12.--Rank ordering of percentages of occurrence for /r/ contexts in singles and blends as a function of syllabic stress--grades 1 and 2 (A), and 3 and 4 (B).*

Singles													Blends							
I/A			I/UA			F/A			F/UA			I/A			I/UA			F/A		
Con.	A	B	Con.	A	B	Con.	A	B	Con.	A	B	Con.	A	B	Con.	A	B	Con.	A	B
rI	16	12	rI	81	65	εr	28	21	εr	0	39	pr	17	19	pr	38	37	rt	27	30
rε	16	16	rə	13	16	Ir	15	12	ɔr	0	17	tr	15	16	tr	38	28	rd	22	10
ri	13	7	ro	6	8	ɔr	15	21	Ir	0	11	gr	14	11	dr	25	2	rm	14	13
re	11	20	rε	0	8	ɑr	13	23	ər	0	11	br	13	11	gr	0	17	rk	8	15
raI	11	11	ræ	0	2	or	8	6	ær	0	6	fr	12	11	fr	0	7	rs	8	5
ro	9	6	ru	0	2	ur	7	5	or	0	6	dr	9	8	kr	0	4	rdʒ	8	0
ru	7	6				ær	6	8	Ur	0	6	str	9	5	br	0	2	rθ	5	0
ræ	4	11				aIr	4	5	aIr	0	6	kr	6	13	str	0	2	rn	5	10
rʌ	4	5				aur	1	2				θr	3	3				rtʃ	3	8
rau	4	0										spr	3	1				rf	0	3
rɑ	2	7										skr	0	2				rl	0	3
rɔ	2	0																rlz	0	3
																		rmpθ	0	3
Total /r/ singles = 277												Total /r/ blends = 235								

* as reported by Dorn (1973)

TABLE 13.--Rank ordering of the frequency of occurrence and percentages for /s/ contexts in singles and blends as a function of syllabic stress--grades 1 and 2.*

Singles												Blends								
I/A			I/UA			F/A			F/UA			I/A			F/A			F/UA		
Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%
sε	22	25	sə	8	62	Is	10	22	Is	8	67	st	19	37	st	19	46	ns	4	67
sI	12	13	sɚ	3	23	εs	9	20	əs	4	33	sp	11	22	ns	8	20	st	2	33
sʌ	11	12	sε	1	8	es	6	13		12		str	7	14	ts	4	10		6	
si	9	10	so	1	8	æs	6	13				sk	4	8	rs	3	7			
saI	9	10		13		is	3	7				sm	3	6	ks	2	5			
sɝ	6	7				ɔs	3	7				spr	2	4	sk	1	2			
se	5	6				aIs	3	7				spl	1	2	nst	1	2			
sɔ	5	6				ʌs	2	4				skw	1	2	ls	1	2			
so	4	4				ɑs	1	2				sn	1	2	ps	1	2			
su	2	2				os	1	2				sl	1	2	kst	1	2			
saU	2	2				us	1	2				sw	1	2		41				
sæ	1	1				aus	1	2					51							
sɔI	1	1				ɔIs	1	2												
	89						45													

Total /s/ singles: 159 Total /s/ blends: 98

* as reported by Schneider (1973)

TABLE 14.--Rank ordering of the frequency of occurrence and percentages for /s/ contexts in singles and blends as a function of syllabic stress--grades 3 and 4.*

Singles

I/A			I/UA			F/A			F/UA		
Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%
sɛ	21	24	sI	14	28	Is	12	16	Is	24	53
sI	15	17	sə	10	20	æs	11	14	əs	10	22
sʌ	11	12	sn̩	10	20	ɛs	10	13	ɛs	5	11
sæ	10	11	sɛ	7	14	ɑs	8	11	aIs	2	4
se	7	8	sl	5	10	ʌs	6	8	ɚs	1	2
sɝ	6	7	sæ	2	4	aIs	5	7	æs	1	2
so	6	7	si	1	2	ɔs	5	7	ɑs	1	2
si	4	4	so	2	2	ɝs	4	5	aUs	1	2
saI	3	3		50		es	4	5		45	
sɔ	2	2				is	4	5			
su	2	2				us	3	4			
sj	1	1				aUs	2	3			
sɑ	1	1				ɔIs	2	3			
	89						76				

Total /s/ singles: 260

* as reported by Schneider (1973)

TABLE 14--Continued

Blends											
I/A			I/UA			F/A			F/UA		
Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%
st	29	33	st	9	75	st	35	57	ns	32	68
sp	20	23	sp	2	17	ks	10	16	st	5	11
sk	14	16	str	1	8	ns	5	8	ks	4	9
str	8	9		12		ts	2	3	ṇs	3	6
sl	6	8				rs	2	3	ls	1	2
skr	3	3				sk	2	3	ts	1	2
skw	2	2				sp	1	2	rs	1	2
sw	2	2				nts	1	2		47	
sm	1	1				ks	1	2			
sn	1	1				mps	1	2			
spl	1	1				dst	1	2			
spr	1	1					61				
	88										

Total /s/ blends: 208

TABLE 15.--Rank ordering of the frequency of occurrence and percentages for /l/ contexts in singles and blends as a function of syllabic stress--grades 1 and 2.*

Singles												Blends								
I/A			I/UA			F/A			F/UA			I/A			F/A			F/UA		
Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%
lɛ	9	18	lI	9	69	Il	12	20	əl	9	75	kl	10	43	gl	2	67	ld	13	46
lɔ	7	14	lə	3	23	ɔl	10	16	ɔl	2	17	bl	4	17	bl	1	33	lf	5	18
le	6	12	laI	1	8	ol	8	13	Il	1	8	fl	4	17		3		lt	4	14
lI	5	10		13		ɛl	6	10		12		gl	2	9				lk	1	4
laI	5	10				ul	4	7				pl	1	4				lθ	1	4
li	4	8				ɑl	4	7				sl	1	4				lp	1	4
lo	4	8				el	3	5				spl	1	4				lv	1	4
læ	3	6				æl	3	5					23					ls	1	4
lʌ	2	4				aIl	3	5										lvs	1	4
lɑ	2	4				Ul	2	3											28	
lɝ	1	2				ɔIl	2	3												
lu	1	2				il	2	3												
lU	1	2				ʌl	1	2												
laU	1	2				ɝl	1	2												
	51						61													
Total /l/ singles: 137												Total /l/ blends: 54								

* as reported by Schneider (1973)

TABLE 16.--Rank ordering of the frequency of occurrence and percentages for /l/ contexts in singles and blends as a function of syllabic stress--grades 3 and 4.*

Singles

I/A			I/UA			F/A			F/UA		
Con.	f	%	Con.	f	%	Con.	f	%	Con.	f	%
lI	14	17	lI	14	47	ɛl	24	21	əl	12	57
laI	10	12	lə	6	20	Il	17	15	Il	3	14
lʌ	10	12	laI	5	17	ɑl	14	12	ʌl	2	10
lɛ	9	11	lo	2	7	æl	12	10	il	1	5
li	8	10	lɚ	2	7	el	10	9	æl	1	5
læ	8	10	lu	1	3	il	6	5	aIl	1	5
le	5	6		30		aIl	6	5	ɔl	1	5
lɑ	5	6				ul	6	5		21	
lu	5	6				ol	5	4			
lɔ	4	5				ɔl	4	3			
lo	2	2				Ul	3	3			
lɝ	1	1				ʌl	3	3			
	81					ɝl	2	2			
						aUl	2	2			
						ɔIl	1	1			
							115				

Total /l/ singles: 247

* as reported by Schneider (1973)

TABLE 16--Continued

Blends

I/A Con.	f	%	I/UA Con.	f	%	F/A Con.	f	%	F/UA Con.	f	%
fl	17	25	pl	2	40	lt	6	27	ld	2	40
kl	17	25	bl	2	40	lf	5	23	fl	1	20
pl	14	21	gl	1	20	lk	3	14	ls	1	20
bl	8	12		5		ld	3	14	lt	1	20
sl	6	9				lm	3	14		5	
gl	5	7				lθ	1	5			
spl	1	1				rl	1	5			
	68						22				

Total /l/ blends: 100

TABLE 17.--Rank ordering of the frequency of occurrence for /r/ contexts in singles and blends as a function of syllabic stress.*

Singles						Blends					
I/A		I/UA		F/A		I/A		I/UA		F/A	
Context	f	Context	f	Context	f	Context	f	Context	f	Context	f
rI	7	rI	13	ɛr	24	pr	13	pr	3	rt	10
rɛ	7	rə	2	Ir	13	tr	12	tr	3	rd	8
ri	6	ro	1	ɔr	13	gr	11	dr	2	rm	5
re	5			ɑr	11	br	10			rk	3
raI	5			or	7	fr	9			rs	3
ro	4			ur	6	dr	7			rdʒ	3
ru	3			ær	5	str	7			rθ	2
ræ	2			aIr	4	kr	5			rn	2
rʌ	2			aur	2	θr	2			rtʃ	1
rau	2					spr	2				
rɑ	1										
rɔ	1										

*as reported by Griffith and Miner (1973)

TABLE 18.--Rank ordering of the frequency of occurrence for /s/ contexts in singles and blends as a function of syllabic stress.*

Singles								Blends					
I/A		I/UA		F/A		F/UA		I/A		F/A		F/UA	
Context	f	Context	f	Context	f	Context	f	Context	f	Context	f	Context	f
sɛ	22	sə	8	Is	10	Is	8	st	19	st	19	ns	4
sI	12	sɚ	3	ɛs	9	əs	4	sp	11	ns	8	st	2
sʌ	11	sɛ	1	es	6			str	7	ts	4		
si	9	so	1	æs	6			sk	4	rs	3		
saI	9			is	3			sm	3	ks	2		
sɝ	6			ɔs	3			spr	2	sk	1		
se	5			aIs	3			spl	1	nst	1		
sɔ	5			ʌs	2			skw	1	ls	1		
so	4			ɑs	1			sn	1	ps	1		
su	2			os	1			sl	1	kst	1		
sau	2			us	1			sw	1				
sæ	1			aus	1								
sɔI	1			ɔIs	1								

* as reported by Griffith and Miner (1973)

TABLE 19.--Rank ordering of the frequency of occurrence for /l/ contexts in singles and blends as a function of syllabic stress.*

Singles								Blends					
I/A		I/UA		F/A		F/UA		I/A		I/UA		F/A	
Context	f	Context	f	Context	f	Context	f	Context	f	Context	f	Context	f
lɛ	9	lI	9	Il	12	əl	9	kl	10	gl	2	ld	13
lɔ	7	lə	3	ɔl	10	ɔl	2	bl	4	bl	1	lf	5
le	6	laI	1	ol	8			fl	4			lt	4
lI	5			ɛl	6			gl	2			lp	1
laI	5			ul	4			pl	1			lk	1
li	4			ɑl	4			sl	1			lv	1
lo	4			el	3			spl	1			lθ	1
læ	3			æl	3							ls	1
lʌ	2			aIl	3							lvz	1
lɑ	2			Ul	2								
lɝ	1			ɔIl	2								
lu	1			il	2								
lU	1			ʌl	1								
lau	1			ɝl	1								

* as reported by Griffith and Miner (1973)

TABLE 20.--Rank ordering of /r/ contexts in singles and blends as a function of syllabic stress according to total subjects percentages of correct productions.

Singles						Blends					
I/A		I/UA		F/A		I/A		I/UA		F/A	
Context	%	Context	%	Context	%	Context	%	Context	%	Context	%
rɑ	55	rə	29	or	59	str	81	pr	86	rθ	67
rI	52	rI	26	aIr	54	tr	76	dr	84	rs	58
rʌ	52	ro	22	ɔr	53	dr	75	tr	54	rdʒ	58
re	46			ɑr	53	θr	61			rn	58
raI	46			ær	43	gr	59			rd	52
ræ	40			Ir	40	spr	54			rt	49
rau	39			aur	39	br	47			rtʃ	45
rɛ	38			ɛr	35	pr	46			rm	37
rɔ	34			ur	26	kr	44			rk	35
ro	28					fr	28				
ri	21										
ru	16										

TABLE 21.--Rank ordering of /s/ contexts in singles and blends as a function of syllabic stress according to total subjects percentages of correct productions.

Singles								Blends					
I/A		I/UA		F/A		F/UA		I/A		F/A		F/UA	
Context	%	Context	%	Context	%	Context	%	Context	%	Context	%	Context	%
si	64	sɛ	64	ɔIs	60	əs	52	st	85	nst	80	st	71
sʌ	62	sə	50	æs	57	Is	50	sn	69	st	76	ns	44
sæ	61	sɚ	49	ɛs	54			str	67	ns	69		
sau	60	so	46	is	52			sm	63	kst	68		
sI	58			Is	50			sw	58	sk	67		
saI	56			aIs	49			sp	57	ts	58		
se	54			ʌs	48			sl	56	ks	57		
sɔ	51			es	46			sk	52	rs	49		
so	50			ɑs	40			skw	51	ls	43		
sɛ	49			ɔs	38			spr	50	ps	36		
su	49			aus	38			spl	36				
sɔI	48			os	37								
sɝ	43			us	31								

TABLE 22.--Rank ordering of /l/ contexts in singles and blends as a function of syllabic stress according to total subjects percentages of correct productions.

Singles								Blends					
I/A		I/UA		F/A		F/UA		I/A		I/UA		F/A	
Context	%	Context	%	Context	%	Context	%	Context	%	Context	%	Context	%
lɛ	90	lə	86	ʌl	81	əl	71	fl	76	gl	62	lk	76
li	90	laI	67	ɑl	62	ɔl	19	sl	76	bl	43	lp	71
lɝ	90	lI	48	ɛl	57			kl	71			lvz	71
lɔ	86			ɔIl	57			bl	71			lf	67
laI	86			il	57			gl	71			ls	62
lɑ	86			Il	52			pl	67			lv	57
lu	86			ul	43			spl	67			lθ	57
lU	86			Ul	43							lt	29
le	81			ɝl	43							ld	10
lʌ	81			el	38								
lo	76			ɔl	33								
læ	76			æl	29								
lau	76			ol	10								
lI	71												

APPENDIX II

DEEP TEST OF ARTICULATION

/r/

NAME____________________ DATE____________________

SEX____________________ GRADE____________________

EXAMINER____________________

INSTRUCTIONS: "I am going to say some words. Watch me and listen very carefully. After I say a word, you say it. Are you ready? Listen, say:"

Singles

1. rich	[rɪ]	______		13. Henry	[rɪ]	______
2. red	[rɛ]	______		14. several	[rə]	______
3. real	[ri]	______		15. railroad	[ro]	______
4. race	[re]	______		16. bear	[ɛr]	______
5. ride	[raɪ]	______		17. clear	[ɪr]	______
6. road	[ro]	______		18. war	[ɔr]	______
7. room	[ru]	______		19. car	[ɑr]	______
8. ran	[ræ]	______		20. four	[or]	______
9. run	[rʌ]	______		21. sure	[ur]	______
10. round	[rau]	______		22. carry	[ær]	______
11. rock	[rɑ]	______		23. tire	[aɪr]	______
12. wrong	[rɔ]	______		24. hour	[aur]	______

Total Correct____________

Blends

1. press	[pr]	______		12. country	[tr]	______
2. trade	[tr]	______		13. hundred	[dr]	______
3. grow	[gr]	______		14. art	[rt]	______
4. break	[br]	______		15. hard	[rd]	______
5. free	[fr]	______		16. farm	[rm]	______
6. draw	[dr]	______		17. dark	[rk]	______
7. string	[str]	______		18. horse	[rs]	______
8. cross	[kr]	______		19. large	[rdʒ]	______
9. three	[θr]	______		20. north	[rθ]	______
10. spread	[spr]	______		21. born	[rn]	______
11. provide	[pr]	______		22. march	[rtʃ]	______

Total Correct____________

Total Singles and Blends Correct____________

DEEP TEST OF ARTICULATION

/s/

NAME______________________________ DATE______________________________

SEX______________________________ GRADE______________________________

EXAMINER______________________________

INSTRUCTIONS: "I am going to say some words. Watch me and listen very carefully. After I say a word, you say it. Are you ready? Listen, say:"

Singles

1.	cent	[sɛ]	______
2.	sick	[sɪ]	______
3.	sun	[sʌ]	______
4.	seat	[si]	______
5.	size	[saɪ]	______
6.	sir	[sɝ]	______
7.	say	[se]	______
8.	saw	[sɔ]	______
9.	so	[so]	______
10.	soon	[su]	______
11.	south	[sau]	______
12.	sat	[sæ]	______
13.	soil	[sɔɪ]	______
14.	person	[sə]	______
15.	officer	[sɚ]	______
16.	necessary	[sɛ]	______
17.	also	[so]	______
18.	kiss	[ɪs]	______
19.	yes	[ɛs]	______
20.	space	[es]	______
21.	pass	[æs]	______
22.	peace	[is]	______
23.	loss	[ɔs]	______
24.	ice	[aɪs]	______
25.	us	[ʌs]	______
26.	possible	[ɑs]	______
27.	close	[os]	______
28.	produce	[us]	______
29.	house	[aus]	______
30.	voice	[ɔɪs]	______
31.	office	[ɪs]	______
32.	various	[əs]	______

Total Correct______________

Blends

1.	stick	[st]	______
2.	speak	[sp]	______
3.	strong	[str]	______
4.	sky	[sk]	______
5.	small	[sm]	______
6.	spring	[spr]	______
7.	explain	[spl]	______
8.	square	[skw]	______
9.	snow	[sn]	______
10.	sleep	[sl]	______
11.	sweet	[sw]	______
12.	best	[st]	______
13.	dance	[ns]	______
14.	its	[ts]	______
15.	horse	[rs]	______
16.	box	[ks]	______
17.	ask	[sk]	______
18.	against	[nst]	______
19.	else	[ls]	______
20.	perhaps	[ps]	______
21.	next	[kst]	______
22.	silence	[ns]	______
23.	forest	[st]	______

Total Correct______________

Total Singles and Blends Correct__________________

DEEP TEST OF ARTICULATION

/l/

NAME________________________________ DATE________________________________

SEX________________________________ GRADE________________________________

EXAMINER________________________________

INSTRUCTIONS: "I am going to say some words. Watch me and listen very carefully. After I say a word, you say it. Are you ready? Listen, say:"

Singles

1. let	[lɛ]	____		18. will	[ɪl]	____
2. lost	[lɔ]	____		19. fall	[ɔl]	____
3. lady	[le]	____		20. soldier	[ol]	____
4. lip	[lɪ]	____		21. fell	[ɛl]	____
5. like	[laɪ]	____		22. fool	[ul]	____
6. leave	[li]	____		23. follow	[ɑl]	____
7. low	[lo]	____		24. sail	[el]	____
8. last	[læ]	____		25. value	[æl]	____
9. love	[lʌ]	____		26. while	[aɪl]	____
10. lot	[lɑ]	____		27. full	[ʊl]	____
11. learn	[lɝ]	____		28. soil	[ɔɪl]	____
12. lose	[lu]	____		29. feel	[il]	____
13. look	[lʊ]	____		30. color	[ʌl]	____
14. allow	[lau]	____		31. girl	[ɝl]	____
15. public	[lɪ]	____		32. real	[əl]	____
16. island	[lə]	____		33. although	[ɔl]	____
17. realize	[laɪ]	____		34. knowledge	[lɪ]	____

Total Correct____________

Blends

1. club	[kl]	____		10. cold	[ld]	____
2. blow	[bl]	____		11. myself	[lf]	____
3. fly	[fl]	____		12. salt	[lt]	____
4. glad	[gl]	____		13. help	[lp]	____
5. complete	[pl]	____		14. milk	[lk]	____
6. sleep	[sl]	____		15. twelve	[lv]	____
7. explain	[spl]	____		16. health	[lθ]	____
8. English	[gl]	____		17. else	[ls]	____
9. probably	[bl]	____		18. themselves	[lvz]	____

Total Correct____________

Total Singles and Blends Correct________________

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