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I am submitting herewith a thesis written by John Carlton Pennington entitled "A Study of the Effects of Syllable Releasing and Arresting Function on the Correct Articulation of /s/ by Normal and Articulatory Defective Children." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Speech Pathology.

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A STUDY OF THE EFFECTS OF SYLLABLE RELEASING AND ARRESTING FUNCTION ON THE CORRECT ARTICULATION OF /s/ BY NORMAL AND ARTICULATORY DEFECTIVE CHILDREN

A Thesis

Presented for the

Master of Arts

Degree

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J. C. P.

ABSTRACT

The purpose of this study was two-fold: (1) to investigate the effects of syllable releasing and arresting function on correct /s/ productions by normal and articulatory defective children; and (2) to investigate the effects of different phonetic environments on correct /s/ productions in syllable releasing and arresting positions by normal and articulatory defective children.

Two groups of five-year-old children, 15 with normal articulation and 15 with defective articulation, were selected as subjects in this study and met the following criteria: normal hearing, normal intelligence, no significant deviation in the structure and/or function of the oral mechanism, and no more than one language (English) spoken in the home. Defective articulation was defined as a score below minus one standard deviation on the 50-item Templin-Darley Screening Test of Articulation while normal articulation was defined as a score above minus one standard deviation on this test.

The speech stimuli were 32 different phonetic context items selected from the McDonald Picture Deep Test of Articulation for the /s/; 16 in which the /s/ occurred in a syllable releasing position and 16 in which the /s/ occurred in a syllable arresting position. After the examiner demonstrated to the subject how to name pairs of pictures

without pausing between them and the child had practiced naming pairs of pictures in this manner, the /s/ phoneme was depp tested with the 32 selected context items for a total of 960 responses. All responses were judged as correct or incorrect by the examiner at the time of testing.

From the results of this study, the following conclusions can be made.

1. There is no significant difference between syllable releasing and arresting positions in the number of correct /s/ productions made by five-year-old children with normal articulation.

2. There are significant differences between syllable releasing and arresting positions in the number of correct /s/ productions made by five-year-old articulatory defective children. Specifically, articulatory defective children correctly produce the /s/ more often when /s/ functions to arrest the syllable than when /s/ functions to release the syllable. Also, these differences vary as a function of the particular phonetic context in which the /s/ occurs.

3. Children with normal articulation make significantly more correct /s/ productions in the syllable releasing position than do articulatory defective children.

4. Children with normal articulation make significantly more correct /s/ productions in the syllable arresting position than do articulatory defective children.

5. There is substantial individual variability in the /s/ responses of articulatory defective children.

6. Further research is indicated to provide more data on the effects of syllable releasing and arresting positions on the articulatory responses of normal and articulatory defective children.

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CHAPTER I

INTRODUCTION

The syllable has been suggested as the basic programmed unit of speech (Ohman, 1966; Kozhevnikov and Chistovich, 1965; McNeilage and DeClark, 1969). The function of a sound in a syllable, that is whether the sound functions to release or arrest the syllable, has been reported to affect the correct production of that sound (Scott and Milisen, 1954; McDonald, 1964; and Ingram, 1974). A search of the literature has revealed few studies which assess correct articulation as a function of syllable releasing and arresting positions and the results of these studies have been equivocal (Scott and Milisen, 1954; and Ingram, 1974). Furthermore, no studies have been reported which investigate differences between normal and articulatory defective children with regard to the effects of syllable releasing and arresting positions on correct articulation.

This study was designed to investigate the influence of syllable releasing and arresting function on correct speech sound production by normal and articulatory defective children. The information obtained from this study should add to our understanding of those factors which bring about the systematic occurrence of correct articulation.

I. REVIEW OF THE LITERATURE

There are many variables which could influence the correct production of a given sound. Some of these are: the function of the phone in a syllable, that is whether it functions to release or arrest the syllable; the phonetic context in which the sound occurs; the age, sex, and dentition of the subject; and the articulatory proficiency of the subject.

Function of the Sound in the Syllable

Several studies have been reported which provide evidence that the function of the sound in a syllable may affect the correct production of that sound (Scott and Milisen, 1954; Appleton, 1969; Zehel et al., 1972; and Ingram, 1974). Some of the results of these studies have been summerized below.

Scott and Milisen (1954) studied consonant production in 64 elementary school children. They reported that in nonsence syllables and words, consonants were produced correctly more often when they released the syllable (or word) than when they arrested the syllable (assuming the function of initial sounds in syllables is to release the syllable, while the function of final sounds in syllables is to arrest the syllable). Other studies have yielded similar results (Templin, 1957). Templin has reported that these differences in accuracy of articulation between initial and final

consonants are greatest at early ages (before age 7); after 7 years they are minimal. At 8 years of age, fricative sounds are still produced less accurately in word final positions than in word initial positions. Furthermore, double-consonant blends are produced correctly more often in the word initial positions than in the word final position, but the reverse is true for triple-consonant blends (Templin, 1957).

During connected speech, the position of a sound in a word (i.e., initial, medial, or final) cannot necessarily be equated with the function of the sound in a syllable, that is, whether the sound functions to release or arrest the syllable. However, because the responses obtained in the studies presented above were single word responses, it seems likely that word initial consonants served to release the first syllable of the stimulus word while word final consonants served to arrest the last syllable of that word.

McDonald (1964) has suggested that initial (releasing) sounds in syllables may be easier to produce because they do not add to the duration of the syllable. According to McDonald, arresting consonants add to the duration of the syllable and, as speaking rate increases, arresting consonants tend to shift to the releasing position in the next syllable where an additional duration is not required.

Appleton (1969) investigated the influence of phonetic context on /s/ and /r/ productions by five-, six-, and seven-

year-old children considered to have normal articulation skills. The /r/ and /s/ phonemes were deep tested in syllable releasing and arresting positions with different adjacent phonetic contexts. Although Appleton did not report differences between syllable releasing and arresting functions, a slightly greater number of correct /s/ productions occurred when the function of /s/ was to arrest the syllable than when the function of /s/ was to release the syllable. The difference was small, however, and not significant when analyzed statistically, by this author, using Appleton's data ($t = 1.52$; $df = 34$; $p < .05$).

Zehel (1972) investigated the influence of broad and immediate phonetic context on /s/ productions by children who misarticulated the /s/ but made few errors on other sounds. The children ranged in age from five to eleven years. While broad context had little influence on /s/ productions, the /s/ was produced correctly significantly more often in some immediate contexts than others. Furthermore, more correct /s/ productions were observed when /s/ arrested the syllable than when it released the syllable. Winitz (1975), when interpreting Zehel's data, did not consider that correct /s/ productions might have been influenced by the function of /s/ within the syllable (i.e., to release or arrest the syllable). Instead, he suggested that observed differences in the number of correct /s/ productions were due to the coarticulatory

effects of item contexts, in which right-to-left coarticulated contexts resulted in more correct /s/ productions than did left-to-right coarticulated contexts. Winitz's hypothesis that sounds are produced correctly more often as a result of right-to-left coarticulation has gained emperical support from Gallagher and Shriner (1975a; 1975b).

Ingram (1974) reported that 1-1/2 years-old children learning a language tend to acquire certain sounds according to their function within the syllable. Specifically, he reported that in consonant-vowel-consonant (CVC) syllables, children acquired back consonants (/k/ and /g/) earlier in the syllable arresting position than in the syllable releasing position and vice versa for front consonants (/p/ and /b/). He contended that an unmarked relationship exists when the releasing consonant of a syllable is more fronted than the arresting consonant. A marked relationship exists when the releasing consonant is less fronted than the arresting consonant. That is, the arresting position in CVC syllables is marked for front consonants and unmarked for back consonants. Ingram suggested that his data were only preliminary support for these contentions and extensive work is still required to verify or refute these claims.

Kressin (1976) studied the effects of raising and falling intonation on consonant production in imitated consonant-vowel-consonant-consonant-vowel-consonant (CVCCVC)

disyllables produced by 2-3 year old normal articulating children. She reported that within each CVC syllable, regardless of whether it was the first or second syllable of a disyllable and regardless of the intonation pattern used, the children made more errors when the first sound in the syllable (the releasing consonant) was more fronted than the last sound in the syllable (the arresting consonant). Stated differently, Kressin's subjects made more errors when the transition from consonant 1 (C_1) to consonant 2 (C_2) in CVC syllables involved articulatory movements from a front sound to a more back sound. Also, children made more errors when the articulatory transitions involved changing from voiceless to voiced or from nasal to oral, regardless of the intonation pattern used.

Research related to the investigation of syllable releasing and arresting position on speech sound production has been equivocal. Obviously, additional study is needed to determine whether certain speech sounds are correctly produced more often when they release the syllable or when they arrest the syllable.

Phonetic Context

The effects of phonetic context on speech sound production have been studied extensively. The results and conclusions obtained from some of these studies include: (1) certain speech sounds are correctly produced significantly

more often in some phonetic contexts than others (Curtis and Hardy, 1959; Appleton, 1969; Zehel et al., 1972; and Gallagher and Shriner, 1975b); (2) immediate phonetic context has a greater influence on correct phone production than does broad phonetic context, that is, sounds not immediately adjacent to the target phoneme (McDonald, 1964; Daniloff and Moll, 1968; and Zehel et al., 1972); (3) both consonant and vowel contexts influence correct phone production (Ohman, 1966; Subtelny, Oya, Subtelny, 1972; Zehel et al., 1972; and Gallagher and Shriner, 1975a, 1975b); and (4) word and syllable boundaries have only minimal effects on the degree to which phonetic context influences phone production (Daniloff and Moll, 1968 and Gallagher and Shriner, 1975a).

The relationship bewteen the influence of phonetic context and syllable releasing and arresting functions on correct phoneme production has not been investigated. Perkins (1952), however, studied the influence of certain sound combinations and word positions on productions of /s/ and /z/. Fifty-six subjects who misarticulated the /s/ or /z/ were tested for correct /s/ and /z/ productions in different sound combinations and word position (initial, medial, and final). The subjects ranged in age from nine to adulthood. Perkins reported that certain sound combinations (phonetic contexts) had greater influence on correct /s/ productions than did the position with which the /s/ occurred in the word. For

correct /z/ productions, position had more importance. The position of sounds in words (i.e., initial, medial and final word positions) cannot necessarily be equated with the function of the sound within a syllable (i.e., syllable releasing and syllable arresting) and thus generalizations from one to the other may be questionable. Until further research is conducted which adequately controls the function of the sound in the syllable as well as the phonetic context in which the sound occurs, no conclusions may be made regarding the relationship between phonetic context and syllable function with regard to their influence on correct speech sound production.

Age

There is experimental evidence to support the assumption that misarticulations in children decrease with age (Poole, 1934; Davis, 1938; Roe and Milisen, 1942; Templin, 1957; Morency, Wepmen, and Weiner, 1967; Van Riper and Ericson, 1969; and Sander, 1973). Davis (1938) reported the age levels at which 100 percent of the children tested correctly articulated consonant sounds. According to Davis, the /s/ phoneme is established in all word positions by age five years-five months. More recently, Sander (1972) reported the earliest age levels at which a simple majority of children produced phonemes correctly in one or more word-positions.

According to Sander, the earliest age for the emergence of the /s/ phoneme is around three years of age.

No one has investigated differences between the effects of syllable releasing and arresting position on speech sound production, as a function of age. Ingram (1974) has reported that about 1-1/2 years of age, children are more likely to produce front consonants correctly when they serve to release the syllable than when they serve to arrest the syllable and vice versa for back consonants. However, additional data are needed to determine at what age this effect may become nonsignificant as a contributor to persisting misarticulations.

Appleton (1969) reported that the consistency of correct /r/ and /s/ productions, by normal articulating children, increases with age, at least between five and seven years. By age seven, normal articulating children tended to produce correctly these phonemes in nearly all the immediate phonetic contexts tested. In addition, the consistency of correct /r/ and /s/ productions increased uniformly, as a function of age, for both syllable releasing and arresting positions.

Sex

Sex differences have been reported rather consistently throughout studies of early articulatory development (Templin, 1952; Poole, 1934; Irwin, 1952). Hall (1938) reported that among the grades two through six, more boys had functional

articulation disorders than did girls. Poole (1934) reported that boys and girls develop efficiency in the articulation of consonants at about the same rate from 2-1/2 to 5-1/2 years of age and that after this age, girls accelerate in articulatory development beyond that of boys, until mature articulation is attained by age 6 or 7. According to Poole, the boys in her study did not reach the same degree of accuracy of articulation until one year later (7 to 8 years-of-age). Templin (1957) also reported that articulation skills in girls approached that of adults approximately one year earlier than did articulation skills in boys.

Dentition

According to Johnson, Darley, and Spriestersbach (1963), the teeth normally play an important role in the production of labiodental, linguadental and postdental fricatives. However, there is empirical evidence to support the view that many speakers adequately compensate for dental deviations (Fymbo, 1936; Snow, 1961; Davis, 1938; Bankson and Byrne, 1962; and Fairbanks and Lentner, 1951).

While some speakers compensate for dental deviations, others do not; particularly in the case of defective sibilants resulting from absence of either upper or lower incisors (Bankson and Byrne, 1962; Snow, 1961; and Davis, 1938). Davis (1938) reported that the /s/ phoneme developed consistently in words at four and five years of age and then became

distorted with a loss of the upper incisors. Such distrotions were observed to disappear, however, following the eruption of the permanent incisors at about eight years of age. Bankson and Byrne (1962) reported that loss of one or more of the upper or lower anterior teeth, among kindergarten and first grade children, significantly affected correct productions of /s/.

Winitz (1969), after reviewing the available literature, concluded that, in general, there is no relationship between the number of permanent teeth erupted or the absence of malocclusion (overbite) and articulation skills among children. However, a significant relationship does exist between the presence of upper and lower incisors and correct articulation of /s/ in all word positions.

Normal and Defective Articulation

The development of speech sounds among young children may be determined to some extent by the function that the sound serves in the syllable, that is, whether the sound functions to release or arrest the syllable (Ingram, 1974). That certain consonants seem to be acquired earlier in syllable-initial positions than in syllable-final positions, or vice versa, may be the result of a general phonological process governed by implicit phonological rules (Ingram, 1974; and Pulgram, 1970).

A child acquires the phonological rules of the language similar to the way that he acquires other linguistic rules, such as syntactic and morphological rules (Fry, 1966). The process of linguistic rule acquisition involves the child's repeated exposure to the adult's linguistic system thus providing ample opportunity to contrast acceptable and unacceptable linguistic contructions (i.e., different combinations of sounds and words). In this way, the child learns the rules for combining acceptable sound and word combinations (Fry, 1966).

According to Fry, the normal child can be expected to acquire a complete and fairly well established phonological system by five to seven years of age. This means the child should be able to correctly articulate all the phonemes of the system, recognize them when produced by others, and correctly select the phonemes which make up the words he uses (Fry, 1966).

Messer (1967) has demonstrated that children (3 to 4 years-of-age), who have internalized the implicit phonological rules of their language, tend to mispronounce phonetic sequences which do not follow these rules. In other words, the English speaking child is likely to misarticulate impossible English words such as [mrul] but not possible English words such as [frul]; provided he has adequately acquired the phonological system of English. Also children

in his study consistently discriminated "possible" from "impossible" phonetic sequences (words) when produced by an adult speaker. Messer concluded that the children had internalized the implicit syntax (rules) of phoneme combination of English; that is, they had acquired the phonological rules of the language.

Clearly, not all children adequately acquire the phonological system of the language (Winitz, 1969). Empirical support of this contention has been provided by Whitacre, Luper and Pollio (1970). Using a format similar to Messer (1967) to investigate the implicit phonological rules of normal and articulatory defective children, these investigators reported that articulatory defective children were less able to discriminate "possible" from "impossible" phonetic sequences than were children with normal articulation. In addition, the articulation defective children were also impaired in other areas of linguistic competence such as knowledge of form class and sentence structure. They concluded that articulatory defective children had not yet acquired the phonological rules of the language as well as certain other aspects of the adult linguistic system.

Leonard (1973) has demonstrated that some articulatory defective children make production errors that do not follow the normal sequence of phonological development. Such children seem to have developed a phonological system that

is different from that of normal children of the same age. McReynolds and Huston (1971) have also reported similar findings among articulatory defective children.

Regarding the articulation errors of children six to eight years of age, Winitz stated:

> It is possible to think of articulation errors for children of about six to eight years of age simply as phoneme systems that are at variance with the adult phoneme system. For some reason the young child has acquired a phoneme system that is not the same as the adult phoneme system. The more the two phoneme systems differ, the more severe is the articulatory defectiveness of the young child. (1969, p. 124)

It appears that the need exists for further investigation of normal and different phonological system development among children.

Summary

In general, a review of the literature has revealed evidence that articulatory defective children use a phonological system which is different from or, at least, less developed than that utilized by normal articulating children. Furthermore, the influence of syllable releasing and arresting functions of consonants in syllables on the acquisition of certain speech sounds may be the result of a general phonological process governed by implicit phonological rules of the language.

If correct articulation is determined (to a degree) by the child's knowledge and correct use of the adult

phonological system (Winitz, 1969), and if the effect of syllable releasing/arresting position on correct speech sound production is the result of a general phonological process at the syllable level (Ingram, 1974), then investigation of speech sound production in syllable releasing and arresting positions by normal and articulatory defective children may provide needed information regarding the nature of normal and deviant phonological systems. Furthermore, knowledge obtained from such an investigation may provide for more effective planning and execution of articulation therapy.

II. PURPOSE OF THE STUDY

The purpose of this study was two-fold: (1) to investigate the effects of syllable releasing and arresting function on correct /s/ productions by normal and articulatory defective children; and (2) to investigate the effects of different phonetic environments on correct /s/ productsions in syllable releasing and arresting positions by normal and articulatory defective children. Specifically, the following questions were asked:

1. Are there differences between syllable releasing and syllable arresting positions in the mean number of correct /s/ productions made by five-year-old normal articulating children?
2. Are there differences between syllable releasing and syllable arresting positions in the mean number

of correct /s/ productions made by five-year-old articulatory defective children?

3. Are there differences between normal and articulatory defective five-year-olds in the mean number of correct productions of /s/ in the syllable releasing position?
4. Are there differences between normal and articulatory defective five-year-olds in the mean number of correct productions of /s/ in the syllable arresting position?
5. What are the effects of phonetic environment on correct /s/ production in syllable releasing and arresting positions for normal and articulatory defective five-year-old children?

CHAPTER II

METHODS AND PROCEDURES

I. SUBJECTS

Criteria for Subject Selection

The subjects selected for this study were thirty, five-year-old children: fifteen with normal articulation and fifteen with defective articulation. Subjects were selected from preschool and kindergarten programs. All subjects met the following criteria.

1. Chronological Age (C.A.) within the range of four years-seven months and five years-eleven months, as determined by school records;
2. Intelligence Quotient (I.Q.) of 85 or above as measured by the Peabody Picture Vocabulary Test (PPVT);
3. No significant deviation in the structure or function of the oral mechanism as determined by an oral peripheral examination.
4. Normal hearing acuity as determined by a hearing screening test for the frequencies 500, 1000, 2000, and 4000 Hz, bilaterally, at 25dB, HTL, re. ANSI, 1969.

5. No previous speech therapy for correction of the /s/ phoneme and from a home where no more than one language (English) was spoken, as determined by the report of the classroom teacher, the parents, and/or school records.
6. Each subject demonstrated either defective articulation skills, as determined by a score on the Templin-Darley Screening Test of Articulation which was below minus one standard deviation from the mean score reported by Templin (1957) or normal articulation, as determined by a score on the Templin-Darley Screening Test of Articulation which was at or above minus one standard deviation from the mean score reported by Templin (1957).

Appendix A presents the chronological age, sex, I.Q., and Templin-Darley Screening Test of Articulation scores for each subject. A summary of subject composition, with ages expressed in years-months, is presented in Appendix B.

Screening for Subjects

Subjects were individually screened at their respective preschool or kindergartens. During testing, the examiner and subject were seated at a child-sized table, directly across from one another, in a room that was as quiet and distraction-free as possible. All testing was accomplished by the investigator during one test session for each subject

(approximately thirty minutes long). The order of test administration during screening included first the Templin-Darley Screening Test of Articulation, then the Peabody Picture Vocabulary Test, the hearing screening, and finally the oral peripheral examination.

II. PROCEDURES

Speech Stimuli and Speech Tasks

The speech stimuli were 32 different phonetic context items selected from the McDonald Picture Deep Test of Articulation (McDonald, 1964). In these contexts, the /s/ phoneme is combined with each of 16 consonants with the /s/ occurring in either a syllable releasing or a syllable arresting position. See Appendix C.

Each subject was tested for correct /s/ productions within each of the 32 immediate phonetic contexts. The stimulus words for the /s/ in the syllable arresting and syllable releasing positions were house and sun, respectively. The stimulus word house was produced in combination with 16 other words to obtain productions of the /s/ in 16 different immediate phonetic contexts in the syllable arresting position. The stimulus word sun was produced in combination with 16 other words to obtain productions of the /s/ in each of 16 different immediate phonetic contexts in the syllable releasing position.

The procedures used for administration of the 32 items were suggested by McDonald (1964). Briefly, these include: (1) the examiner's demonstration to the child how to name two pictures without pausing between them, (2) allowing the child to practice naming pairs of pictures in this manner, and (3) testing the /s/ phoneme within each of the 32 selected contexts.

Judging Responses

Thirty-two /s/ responses were elicited from each subject. Each /s/ response was judged as correct or incorrect by the investigator at the time of testing. If at any time, the investigator had difficulty determining the correctness or incorrectness of a given response, the subject was requested to repeat the response again. The subject's most accurate response was the response scored.

CHAPTER III

RESULTS

Thirty subjects, fifteen with normal articulation and fifteen with defective articulation, each produced 32 selected context items for the /s/ (16 in a syllable releasing position and 16 in a syllable arresting position) for a total of 960 responses. The range of correct responses in each syllable position was 0 to 16 for each subject. The criterion measure was the number of correct responses for each subject in each syllable position.

I. RELIABILITY

A graduate student in speech pathology judged the responses of five, randomly selected, subjects at the time of testing. One week following the initial testing procedure, these subjects were retested and their responses judged again by the investigator and the same graduate student. In addition, all responses from these five subjects were tape recorded on a tape recorder (Wollensak, Model 1500 SS) during the initial testing sessions. The resulting tape was then edited to eliminate any extraneous speech from the examiner and subjects (Ampex, Model AG440B). A certified speech pathologist then listened to the edited tape recording and scored the /s/ responses as correct or incorrect. Before

judging the tape recorded responses, the speech pathologist had been instructed to listen to each subject's response as many times as necessary to make the most accurate judgment about the correctness or incorrectness of the /s/ production. The obtained data were used in computing intra- and interjudge reliability using the formula:

$$\text{Percent agreement} = \frac{A}{A+D} \quad ;$$

where A equals the number of agreements and D equals the number of disagreements. Appendix D presents a summary of intra- and interjudge percent agreement scores.

Intrajudge Reliability

Intrajudge reliability was determined for the investigator (Judge 1) and the speech pathology graduate student (Judge 2) by computing percent agreement scores between the two test sessions (i.e., the initial test sessions and the session one week later). Agreement between test sessions was 94 percent and 94 percent for Judge 1 and Judge 2, respectively. These indices of reliability are in agreement with those of Hill (1973) and Appleton (1969) who reported studies which involved similar response judgments.

Interjudge Reliability

The judged responses obtained during the initial testing procedure by Judge 1 and Judge 2 and the judged responses of

the certified speech pathologist (Judge 3) were used to compute agreement scores among the judges. Agreement between Judges 1 and 2, between Judges 1 and 3, and between Judges 2 and 3 were 95, 95, and 92 percent, respectively. These indices of reliability are in agreement with those reported by Hill (1973) and Appleton (1969) which involved similar response judgments.

II. STATISTICAL ANALYSIS

The range of correct responses for the syllable releasing and arresting positions was 11 to 16, with a mean of 15.2, and 14 to 16, with a mean of 15.0, respectively, for the normal articulation group and 0 to 16, with a mean of 8.3, and 0 to 16, with a mean of 11.1, respectively, for the articulatory defective group. The median scores for syllable releasing and arresting positions were 16.0 and 15.0, respectively, for the normal group and 11.0 and 12.0, respectively, for the articulatory defective group. Table 1 presents a summary of the number of correct /s/ responses for syllable releasing and arresting positions for each subject in both speaking groups.

A two-factor analysis of variance design with repeated measures on one factor was used to analyze the effects of syllable position (releasing and arresting), the effects of the two articulation groups (normal and defective), and the

TABLE 1. Summary of subjects' correct responses in syllable releasing and arresting positions for both articulation groups (normal and defective).

	NORMAL			DEFECTIVE	
	Syllable			Syllable	
SUBJECT	Releasing	Arresting	SUBJECT	Releasing	Arresting
S_1	15	16	S_{16}	5	12
S_2	11	15	S_{17}	15	14
S_3	14	15	S_{18}	14	16
S_4	16	15	S_{19}	11	13
S_5	16	14	S_{20}	15	14
S_6	16	15	S_{21}	0	12
S_7	16	15	S_{22}	0	0
S_8	16	16	S_{23}	3	11
S_9	15	16	S_{24}	7	3
S_{10}	16	15	S_{25}	13	13
S_{11}	16	16	S_{26}	13	12
S_{12}	15	14	S_{27}	0	4
S_{13}	16	14	S_{26}	0	11
S_{14}	16	14	S_{29}	13	16
S_{15}	14	15	S_{30}	16	16
Group Totals	228	225		125	167
Group Means	15.2	15.0		8.3	11.1

effects of interaction between articulation groups and syllable positions. The results were presented in Table 2. An analysis of Table 2 reveals that (1) the normal and defective articulatory groups differed significantly in the number of correct /s/ productions, irrespective of the syllable position in which the /s/ phone occurred ($F = 19.37$, $df = 1/30$, $p < .001$); (2) syllable releasing and arresting psotions differed significantly ($F = 5.91$, $df = 1/30$, $p < .025$); and (3) the interaction between syllable positions and articulation groups was significant ($F = 7.73$, $df = 1/30$, $p < .01$) indicating that the effects of syllable position on the number of correct /s/ productions were different for the normal and articulatory defective groups (see Figure 1).

Analysis of Figure 1 reveals that the mean difference between syllable releasing and arresting positions for the normal articulation subjects (0.2) was significantly less than the mean difference between syllable releasing and arresting positions for the articulatory defective subjects (2.8). Although the difference was slight (0.2) for the normal speakers, more correct responses occurred in the syllable releasing position than in the arresting position and this trend is reversed for the articulatory defective speakers. Also, the mean syllable releasing and arresting scores were higher for the normal articulation group than for the defective articulation group. Because of the difference

TABLE 2. Summary of analysis of variance for evaluating differences between syllable positions (releasing and arresting) and articulation groups (normal and defective).

Source	SS	df	ms	F*	p**
Total	1239	59	———	———	———
Between subjects	1057	29	———	———	———
Groups (G)	432	1	432.0	19.37	0.001
$Error_b$	625	28	22.3	———	———
Within subjects	182	30	———	———	———
Syllable positions (SP)	26	1	26.0	5.91	0.025
SP X G	34	1	34.0	7.73	0.01
$Error_w$	122	28	4.4	———	———

*F rations: ms_G / ms_{error_b}; ms_{SP} / ms_{error_w}; $ms_{SP \times G}$ / ms_{error_w}.

**Level of significants.

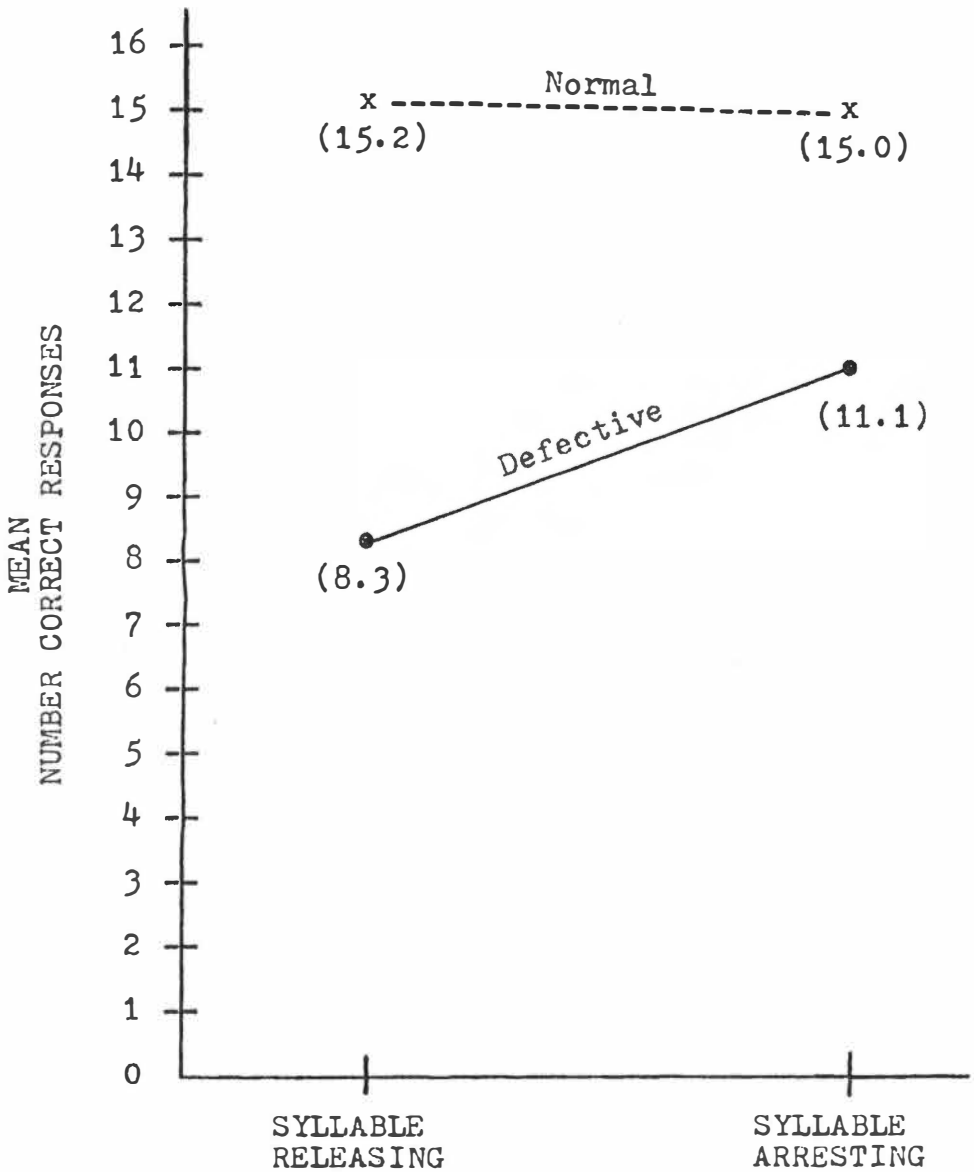

FIGURE 1. Mean number of correct responses in syllable releasing and arresting positions for both articulation groups (normal and defective).

between the mean syllable releasing and arresting scores for the two articulation groups (i.e., normal and defective), it was necessary to investigate the differences in syllable releasing and arresting scores both within and between the two groups.

III. DIFFERENCES BETWEEN SYLLABLE RELEASING AND ARRESTING POSITIONS FOR CHILDREN WITH NORMAL ARTICULATION SKILLS

The range of correct responses for the normal speaking group was 11 to 16, with a mean of 15.2, for the syllable releasing position, and 14 to 16, with a mean of 15.0 for the syllable arresting position. The median scores were 16.0 and 15.0 for the syllable releasing and arresting positions, respectively.

A t-test for related measures was used to analyze differences bewteen syllable releasing and arresting positions for the normal articulation group. The difference between the means of the syllable positions (0.2) was not significant ($t = 0.48$, $df = 14$, $p > .05$).

Analysis of Table 1, page 24, reveals that individual differences of the normal speaking subjects were small (two or less) except for subject two, where the difference between syllable positions was only four. Also, the number of correct responses was consistently high (approximately 15 correct out of 16 possible) for both syllable releasing and arresting

positions. Figure 2 graphically illustrates individual subject scores for syllable releasing and arresting positions for the normal speaking children.

IV. DIFFERENCES BETWEEN SYLLABLE RELEASING AND ARRESTING POSITIONS FOR CHILDREN WITH DEFECTIVE ARTICULATION SKILLS

The range of correct responses for the defective articulation group was 0 to 16, with a mean of 8.3, for the syllable releasing and 0 to 16, with a mean of 11.1 for the syllable arresting position. The medians were 11.0 and 12.0 for the syllable releasing and arresting positions, respectively.

A t-test for related measures was used to analyze differences between syllable releasing and arresting positions for the articulatory defective group. The difference between the means of the syllable positions (2.8) was significant ($t = 2.33$, $df = 14$, $p < .05$).

Analysis of Table 1, page 24, reveals that the articulatory defective subjects were very inconsistent. The range of differences between syllable positions was large (0 to 12) with six subjects having a difference of four or more. Also, responses were not consistently correct more often in one syllable position than the other as evidenced by the fact that four subjects made more correct responses in the releasing position while the remaining eleven subjects made more correct responses in the arresting position.

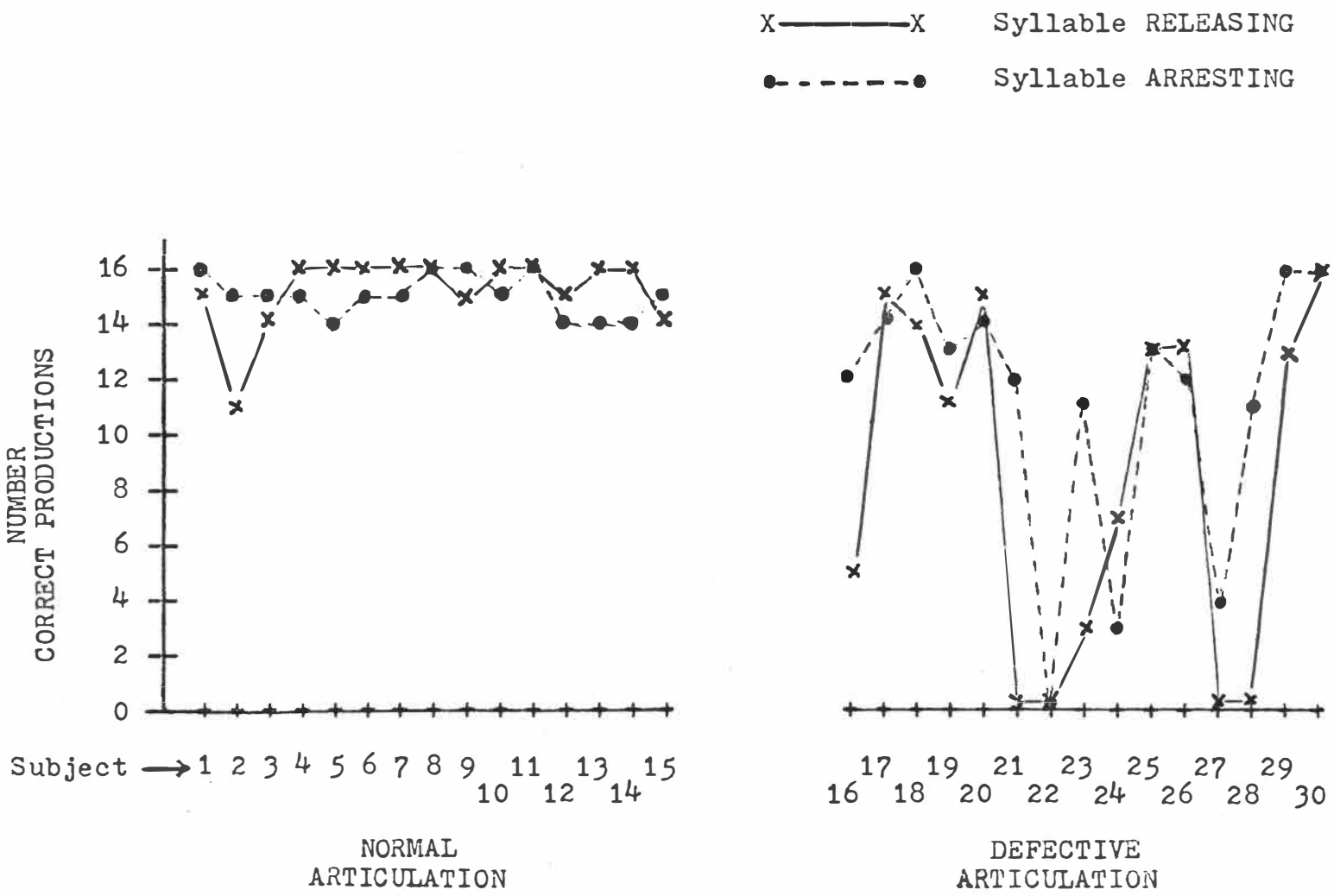

FIGURE 2. Number of correct /s/ productions in syllable releasing and arresting positions for each of the thirty subjects.

V. DIFFERENCES BETWEEN NORMAL AND ARTICULATORY DEFECTIVE CHILDREN PRODUCING THE /s/ IN A SYLLABLE RELEASING POSITION

The range of correct responses was 11 to 16, with a mean of 15.2 for the normal speaking subjects. The range of correct responses was 0 to 16, with a mean of 8.3 for the articulatory defective subjects. The median scores were 16.0 and 11.0 for the normal and articulatory defective subjects, respectively.

A t-test for related measures was used to analyze differences between normal and articulatory defective groups for the number of correct /s/ productions in the syllable releasing position. The difference between the means of the two articulatory groups (6.90) was significant ($t = 3.79$, $df = 14$, $p < .01$). This findings was expected since subjects were assigned to groups according to their articulation skills (i.e., normal or defective) and one would expect more correct responses from normal subjects. However, analysis of individual differences (Table 1, page 24, and Figure 2), reveals that eight articulatory defective subjects made scores which fell within the range of scores for the normal articulation group (11 to 16), indicating that the responses of those eight subjects were similar to those in the normal group.

VI. DIFFERENCES BETWEEN NORMAL AND ARTICULATORY DEFECTIVE CHILDREN PRODUCING THE /s/ IN THE SYLLABLE ARRESTING POSITION

The range of correct responses was 14 to 16, with a mean of 15.0, for the normal articulation group. The range of correct responses was 0-16 with a mean of 11.1 for the articulatory defective group. The median scores were 15.0 and 12.0 for the normal and defective subjects, respectively.

A t-test for related measures was used to analyze differences between normal and defective speaking subjects producing the /s/ in the syllable arresting position. The difference between the means of the two articulation groups (3.9) was significant ($t = 3.25$, $df = 14$, $p < .01$). See Table 1, page 24. Again, this findings was not surprising due to the subject composition of the two groups.

An analysis of individual differences (Table 1 and Figure 2, page 30) reveals that five of the articulatory defective subjects made syllable arresting scores that approximated those of the normal subjects (i.e., made scores of 14 or more). This finding is consistent with the previous reported finding that some of the defective speakers made syllable releasing responses similar to those of the normal speakers.

VIII. DIFFERENCES IN PHONETIC CONTEXT

The effects of phonetic context on correct /s/ phone production for syllable releasing and arresting positions

within the two articulation groups are illustrated graphically in Figure 3. Data for individual contexts are presented in Appendix E.

Inspection of Figure 3 reveals that the effects of phonetic context were not equal for the two syllable positions for both articulation groups. There were no contexts which consistently (i.e., both syllable positions) resulted in substantially more correct /s/ productions in either of the articulation groups. However, in the normal group, one context (/ʃ/) consistently resulted in substantially fewer correct /s/ productions. In the articulatory defective group, the /ʃ/, /tʃ/, and /dʒ/ resulted in substantially fewer correct /s/ productions in the syllable releasing position than in the syllable arresting position. Normal speakers made more correct responses when /s/ was adjacent to /b/ and /θ/ in the syllable arresting position. When /s/ was in a syllable releasing position, more correct responses were made when the /s/ was adjacent to /m/, /f/, /dʒ/, and /l/. There was no difference between syllable positions when /s/ was produced adjacent to /p/, /t/, /d/, /k/, /g/, /n/, /v/, /ʃ/, /tʃ/, and /r/. In the articulatory defective group, there were no phonetic contexts in which more correct /s/ responses occurred in the syllable releasing position than in the syllable arresting position. Also, there was no difference between syllable positions when /s/ was adjacent to /f/ and /v/.

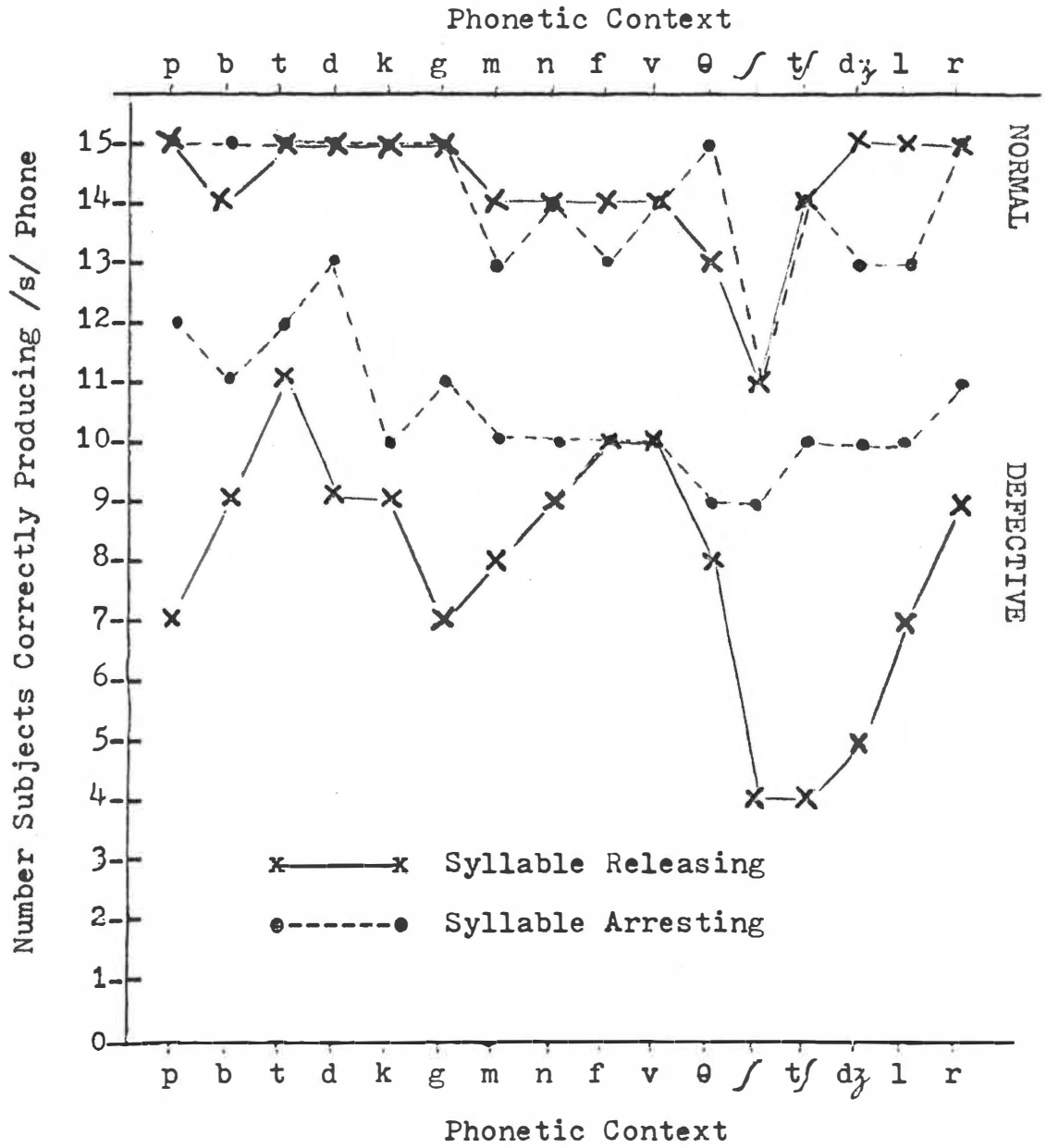

FIGURE 3. Number of subjects correctly producing the /s/ in Syllable releasing and arresting positions for each phonetic context.

In the normal articulation group, differences between the syllable positions were small (two or less) for all the contexts tested. In the articulatory defective group, such differences tended to be large (three or more) for some of the contexts tested. (See Appendix E.)

To further analyze differences between syllable positions among the phonetic contexts for the defective articulation group, the pnonetic contexts were grouped according to the degree of difference between the syllable positions. An arbitrary difference of three was chosen as the criteria for separating the phonetic contexts into two groups: (1) those contexts in which there were large differences (three or more) in the number of correct responses between the syllable positions and (2) those contexts in which there were small differences (two or less) in the number of correct responses between the syllable positions. A summary of differences between syllable releasing and arresting positions for each of the 16 phonetic contexts for the articulatory defective speakers is presented in Table 3.

Analysis of Table 3 reveals that differences of three or more occurred between the syllable positions when /s/ was adjacent to /p/, /d/, /g/, /ʃ/, /tʃ/, /dʒ/, or /l/ and differences of two or less occurred between the syllable positions when /s/ was adjacent to /b/, /t/, /k/, /m/, /n/, /f/, /v/, /θ/, or /r/. Furthermore, the articulatory

TABLE 3. Summary of differences between syllable releasing and arresting positions for each phonetic context as produced by 15 articulatory defective subjects.

Context	Releasing/Arresting		Difference of 3 or more	Difference of 2 or less
p	7	12	5	
d	9	13	4	
g	7	11	4	
ʃ	4	9	5	
tʃ	4	10	6	
dʒ	5	10	5	
l	7	10	3	
b	9	11		2
t	11	12		1
k	9	10		1
m	8	10		2
n	9	10		1
f	9	9		0
v	10	10		0
θ	8	9		1
r	9	11		2

defective subjects made considerably more correct responses when /s/ was in the syllable arresting position and adjacent to /p/, /d/, /g/, /ʃ/, /tʃ/, /dʒ/, or /l/. Considerably fewer correct responses were made when /s/ was in the syllable releasing position and adjacent to these sounds.

Of those contexts in which there was the greatest difference between syllable positions (/sp/, /sd/, /sg/, /sʃ/, /stʃ/, /sdʒ/ and /sl/), there appeared to be no evidence of common distinctive features; specifically the features of place of articulation, manner of articulation, and voicing. The phonetic contexts were not similar in place features since there was one of six front placements (/p/), two of four front-middle placements (/d/, /l/), three of four back-middle placements (/ʃ/, /tʃ/, /dʒ/), and one of two back placements (/g/). The phonetic contexts were not similar in manner of production since there were three stops (/p/, /d/, /g/), one fricative (/ʃ/), two affricates (/tʃ/, /dʒ/), and one glide (/l/). Finally, the contexts were not similar in the voicing feature since four of the contexts were voiced (/d/, /g/, /dʒ/, and /l/) and three were unvoiced (/p/, /ʃ/, /tʃ/).

VIII. SUMMARY OF RESULTS

In summary, the results of this study indicate that articulatory defective subjects made significantly more

correct /s/ responses in the syllable arresting position than in the syllable releasing position where as syllable position had little effect on the number of correct /s/ productions by the normal articulation children, although they made slightly more correct /s/ productions in the releasing position than in the arresting position. The normal subjects as a group made more correct /s/ productions than did the articulatory defective subjects regardless of the syllable position in which the /s/ phoneme occurred, but the difference between the groups was greater when /s/ was in the syllable releasing position. Differences were small between the syllable positions for all the phonetic contexts tested in the normal groups. Differences between the syllable positions were large for some of the contexts tested in the articulatory defective group. In the articulatory defective group, substantially more correct /s/ productions were made in the syllable arresting position than in the syllable releasing position when /s/ was adjacent to /p/, /d/, /g/, /ʃ/, /tʃ/, /dʒ/, or /l/ and these contexts were not systematically similar in terms of place of articulation, manner of articulation, or voicing. There were no phonetic contexts which resulted in substantially more correct /s/ productions in both syllable positions for either articulation group. However, substantially fewer correct productions occurred in both syllable positions of the normal group when /s/ was

adjacent to /ʃ/. In the articulatory defective group, the /ʃ/, /tʃ/, and /dʒ/ resulted in substantially fewer correct productions in the releasing position but not the arresting position.

CHAPTER IV

DISCUSSION

I. DIFFERENCES BETWEEN SYLLABLE RELEASING AND ARRESTING POSITIONS FOR CHILDREN WITH NORMAL ARTICULATION

The results of this study indicate that there are no statistically significant differences in correct /s/ productions between syllable releasing and arresting positions for children with normal articulation skills. This finding is in agreement with Appleton's (1969) reported data, which when analyzed statistically by the present investigator, revealed no significant difference between the syllable positions for the normal articulating children.

Although the difference was not significant, more correct responses were observed when /s/ was in the syllable releasing position than when it was in the syllable arresting position. Analysis of Appleton's data reveals that her subjects made more correct /s/ responses when /s/ was in the syllable arresting position. It appears that the variation between these studies was likely due to chance since the differences between syllable positions were small and not significant statistically in both sutdies. A search of the literature has not revealed other investigators who have studied differences between syllable positions among normal speaking children.

II. DIFFERENCES BETWEEN SYLLABLE RELEASING AND ARRESTING POSITIONS FOR CHILDREN WITH DEFECTIVE ARTICULATION

The results of this study indicate that there are statistically significant differences between syllable releasing and arresting positions in the number of correct responses by articulatory defective children. The children with defective articulation made more correct /s/ productions when /s/ functioned to arrest the syllable than when it functioned to release the syllable. These results are consistent with the reported findings of Zehel et al. (1972) indicating that articulatory defective subjects made more correct /s/ responses in the syllable arresting position than in the releasing position. A search of the literature has not revealed other investigators who have studied differences between syllable releasing and arresting positions among children with defective articulation. Ingram (1974) reported that, among young normal children, front consonants will more easily be acquired in the syllable releasing position than in the syllable arresting position, and back consonants will be acquired in the syllable arresting positions before the syllable releasing position. The results of this investigation do not support Ingram's results. In the present study articulatory defective children seemed to produce more easily the /s/ (which is more fronted than back) when it occurred in the syllable arresting position than in the syllable

releasing position. However, these differences between the sutides may be due to different criteria for subject selection (i.e., differences in age and articulation skills).

Scott and Milisen (1954) have reported that, in isolated word productions, consonants are produced correctly more often in the initial word position than in the final word position. Assuming that the function of initial consonants in words is to release the first syllable of that word and the function of final consonants in words is to arrest the final syllable of that word, one would not expect more correct consonant productions in the syllable releasing position, at least during isolated word productions.

A possible explanation for the results of the present study may be related to the particular speech tasks involved. Subjects in Scott and Milisen's study were required to produce single word responses. Subjects' productions in the present study were essentially disyllabic (only one stimulus item was trisyllabic—"housegiraffe") and composed of two abutted linguistically unrelated words. If indeed, the syllable is the basic programmed unit of speech, as suggested (Ohman, 1966; Koshevnikov and Chistovich, 1965; and McNeilage and DeClark, 1969), it may be that children with defective articulation are somewhat less accurate at programming sequential syllables, and thus, the programming of the first syllable may interfere with the accurate programming of the

following syllable. While this explanation may account for differences between this study and studies of single word productions, research is not yet available to support this contention.

III. DIFFERENCES BETWEEN NORMAL AND ARTICULATORY DEFECTIVE CHILDREN PRODUCING THE /s/ IN THE SYLLABLE RELEASING POSITION

The results of this study indicate that there are statistically significant differences between normal and articulatory defective children for the number of correct /s/ productions in the syllable releasing position. That is, normal children were more consistent in their correct /s/ productions than the articulatory defective children. This finding was not surprising, however, since subjects were assigned to articulation groups according to their articulation skills (i.e., normal or defective). One might expect normal children to produce more correct /s/ productions than articulatory defective children, regardless of the syllable position in which the /s/ occurred. A search of the literature has not revealed any other investigators who have studied differences between normal and articulatory defective children with regard to consonant production in the syllable releasing position.

These results may be compared with the results of studies which report differences in the consistency of

correct consonant production as a function of age, if one accepts the assumption that many children with defective articulation utilize a phoneme system that is different than that of normal children. McDonald (1964) and Appleton (1969) have reported that young children show a significant increase in the consistency of correct consonant production as a function of increasing age. By age seven, children with normal articulation tend to correctly produce the /s/ in most phonetic contexts in both the syllable releasing and arresting positions (Appleton, 1969). Also, the consistency of correct production increases uniformly, as a function of age, for both syllable positions (Appleton, 1969). Since the difference between syllable positions was significant for the articulatory defective subjects of the present study, it is unlikely that the consistency of correst /s/ productions will increase uniformly in both syllable positions as a function of age. Thus, the articulatory defective children in the present study may be utilizing a different phonological system than normal children. To date, the uniformity with which articulatory defective children increase in their consistency of correct articulation has not been determined for either syllable releasing or arresting positions. Also, additional research data are needed to specify age changes in the articulatory defective group.

IV. DIFFERENCES BETWEEN NORMAL AND ARTICULATORY DEFECTIVE CHILDREN PRODUCING THE /s/ IN THE SYLLABLE ARRESTING POSITION

The results of this study indicate that there are statistically significant differences between normal and articulatory defective children in the number of correct /s/ responses in the syllable arresting position. The children with normal articulation made more correct responses than did the children with defective articulation. This finding was also expected since children were assigned to the articulation groups according to their articulation skills (i.e., normal or defective). As discussed earlier, one would expect normal children to make more correct /s/ productions. Differences between normal and articulatory defective children with regard to the number of correct /s/ productions observed in the syllable arresting position have not been previously reported.

V. DIFFERENCES IN PHONETIC CONTEXT

The results of this study indicate that differences in the number of correct productions were small between the syllable positions for all phonetic contexts tested in the normal articulation group while differences between syllable positions were large for some of the contexts tested in the articulatory defective group. A search of the literature has not revealed other investigators who have studied the

effects of syllable position and phonetic context on correct phone production among normal speaking children. However, Zehel et al. (1972) has reported that, among articulatory defective children, differences in the number of correct /s/ responses exist between syllable releasing and arresting positions and these differences varied as a function of the particular phonetic context in which the /s/ occurred.

The results of this study also indicate that the articulatory defective children made substantially more correct /s/ responses in the syllable arresting position when /s/ was adjacent to /p/, /d/, /g/, /ʃ/, /tʃ/, /dʒ/, or /l/. Furthermore, these phones were not systematically similar in terms of place of articulation, manner of articulation, or voicing. These results are not consistent with the results reported by Gallagher and Shriner (1975) that normal children made more correct /s/ responses during spontaneous speech when /s/ was followed by phones similar to the /s/ in place of articulation.

A possible explanation for the difference in findings may be related to differences in elicitation procedures. Gallagher and Shriver studied responses of normal children during spontaneous speech while the present study investigated responses of both normal and defective speakers to formal articulation testing.

Another possible explanation for these differences may be related to individual subject variation. Some of the

articulatory defective subjects in the present study exhibited consistent omission or substitution errors in one or both syllable positions. The error patterns of these children were so well established that neither syllable position nor phonetic context had an effect on correct /s/ productions. In the present study, no attempt was made to determine the degree to which these subjects were stimulable given auditory or visual cues by the investigator. It may be that the degree to which the /s/ is stimulable, for a given child, for either syllable position, significantly affects the degree to which phonetic context influences correct /s/ productions. Also, in the present study, there was no attempt to control for defective sounds other than the /s/. It could be that the presence of other defective sounds affected the listener's perception of correct /s/ productions. Furthermore, when studying the effects of phonetic context on correct /s/ production (or any phone production) the ability of the subjects to correctly produce the phones adjacent to the /s/ must be considered.

VI. SUGGESTIONS FOR FUTURE RESEARCH

The results of this study indicate the need for further research to provide more data on the effects of syllable releasing and arresting positions on the articulatory responses of normal and articulatory defective children.

Specifically, the following areas of investigation are indicated:

1. Since the effects of syllable position on correct /s/ production are greatest among articulatory defective subjects, further research is needed to determine if this trend is consistent for other consonants, other age groups, and spontaneous speech samples.

2. Research is needed to determine if the stimulability of defective consonants is affected by syllable position and if so, is the effect the same for different consonants.

3. Since large difference between syllable positions were specific to particular phonetic contexts in the articulatory defective group, a study similar to the present one is needed using a larger number of subjects with varying degrees of severity to determine if this trend is consistent.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was two-fold: (1) to investigate the effects of syllable releasing and arresting function on correct /s/ productions by normal and articulatory defective children; and (2) to investigate the effects of different phonetic environments on correct /s/ productions in syllable releasing and arresting positions by normal and articulatory defective children.

Two groups of five-year-old children, 15 with normal articulation and 15 with defective articulation, were selected as subjects in this study and met the following criteria: normal hearing, normal intelligence, no significant deviation in the structure and/or function of the oral mechanism, and no more than one language (English) spoken in the home. Defective articulation was defined as a score below minus one standard deviation on the 50-item Templin-Darley Screening Test of Articulation while normal articulation was defined as a score above minus one standard deviation on this test.

The speech stimuli were 32 different phonetic context items selected from the McDonald Picture Deep Test of Articulation for the /s/; 16 in which the /s/ occurred in a syllable releasing position and 16 in which the /s/ occurred in the syllable arresting position. After the examiner

demonstrated to the subject how to name pairs of pictures without pausing between them and the child had practiced naming pairs of pictures in this manner, the /s/ phoneme was deep tested within the 32 selected context items for a total of 960 responses. All responses were judged as correct or incorrect by the examiner at the time of testing.

From the results of this study, the following conclusions can be made.

1. There is no significant difference between syllable releasing and arresting positions in the number of correct /s/ productions made by five-year-old children with normal articulation.

2. There are significant differences between syllable releasing and arresting positions in the number of correct /s/ productions made by five-year-old articulatory defective children. Specifically, articulatory defective children correctly produce the /s/ more often when /s/ functions to release the syllable. Also, these differences vary as a function of the particular phonetic context in which the /s/ occurs.

3. Children with normal articulation make significantly more correct /s/ productions in the syllable releasing position than do articulatory defective children.

4. Children with normal articulation make significantly more correct /s/ productions in the syllable arresting position than do articulatory defective children.

5. There is substantial individual variability in the /s/ responses of articulatory defective children.

6. Further research is indicated to provide more data on the effects of syllable releasing and arresting positions on the articulatory responses of normal and articulatory defective children.

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APPENDICES

APPENDIX A

TABLE 4. Sex, chronological age (C.A.), Peabody Picture Vocabulary Test (PPVT) I.Q., and Templin-Darley Screening Test of Articulation score for each of the normal and articulatory defective subjects.

Subject	C.A. (years-months)	PPVT I.Q.	Templin-Darley Articulation Score	Sex
		Normal Articulation		
1	5-1	129	47	Male
2	5-5	112	47	Male
3	5-2	103	48	Female
4	5-0	97	42	Female
5	4-10	106	46	Male
6	5-3	103	37	Male
7	4-9	97	49	Male
8	4-10	103	44	Male
9	5-2	132	39	Male
10	5-2	108	49	Female
11	5-1	119	42	Male
12	5-5	106	48	Female
13	4-11	110	49	Female
14	5-0	104	25	Male
15	5-5	101	32	Male
		Defective Articulation		
16	5-6	110	18	Male
17	5-5	95	23	Female
18	5-3	104	16	Male
19	5-0	106	24	Male
20	5-0	91	18	Female
21	5-0	114	8	Male
22	4-7	139	1	Female
23	5-6	95	15	Male
24	5-1	110	21	Male
25	5-4	110	24	Male
26	5-5	85	13	Female
27	5-3	97	15	Male
28	5-8	110	7	Male
29	5-11	106	9	Male
30	5-8	102	23	Female

APPENDIX B

TABLE 5. Subject composition indicating the range and mean chronological ages, intelligence quotients and Templin-Darley Screening Test of Articulation scores for the normal and articulatory defective subjects.

	Sex	Mean C.A.	Range C.A.	Mean I.Q.*	Range I.Q.	Mean Artic. Score	Range Artic. Score
Defective articulation	10 males 5 females	5-4	4-7 to 5-11	105	85 to 139	15.7	1 to 24
Normal articulation	10 males 5 females	5-1	4-9 to 5-5	109	97 to 132	42.9	25 to 49

*Intelligence Quotient as determined by the Peabody Picture Vocabulary Test.

APPENDIX C

TABLE 6. Speech stimuli.

Phonetic context	Speech stimuli with /s/ in the syllable releasing position	Phonetic context	Speech stimuli with /s/ in the syllable arresting position
/ps/	CUPsun	/sp/	housePIPE
/bs/	TUBsun	/sb/	houseBELL
/ts/	KITEsun	/st/	houseTIE
/ds/	BEDsun	/sd/	houseDOG
/ks/	DUCKsun	/sk/	houseCOW
/gs/	PIGsun	/sg/	houseGUN
/ms/	COMBsun	/sm/	houseMOON
/ns/	PINsun	/sn/	houseKNIFE
/fs/	LEAFsun	/sf/	houseFORK
/vs/	FIVEsun	/sv/	houseVASE
/θs/	TEETHsun	/sθ/	houseTHUMB
/ʃs/	FISHsun	/sʃ/	houseSHEEP
/tʃs/	WATCHsun	/stʃ/	houseCHAIR
/dʒs/	CAGEsun	/sdʒ/	houseGIRAFFE
/ls/	BALLsun	/sl/	houseLAMP
/rs/	CARsun	/sr/	houseRAKE

APPENDIX D

Percent agreement scores for intra- and interjudge reliability.

Intrajudge agreement: Judge 1

$$\frac{120 \text{ agreements}}{8 \text{ disagreements}} = 94 \text{ percent agreement}$$

Intrajudge agreement: Judge 2

$$\frac{120 \text{ agreements}}{8 \text{ disagreements}} = 94 \text{ percent agreement}$$

Interjudge agreement: Judge 1 and Judge 2

$$\frac{152 \text{ agreements}}{8 \text{ disagreements}} = 95 \text{ percent agreement}$$

Interjudge agreement: Judge 1 and Judge 3

$$\frac{138 \text{ agreements}}{8 \text{ disagreements}} = 95 \text{ percent agreement}$$

Interjudge agreement: Judge 2 and Judge 3

$$\frac{108 \text{ agreements}}{8 \text{ disagreements}} = 92 \text{ percent agreement}$$

APPENDIX E

TABLE 7. Number of subjects correctly producing /s/ in syllable releasing and arresting positions for each phonetic context.

Context	Normal Articulation		Defective Articulation	
	A	B	A	B
/p/	15	15	7	12
/b/	14	15	9	11
/t/	15	15	11	12
/d/	15	15	9	13
/k/	15	15	9	10
/g/	15	15	7	11
/m/	14	13	8	10
/n/	14	14	9	10
/f/	14	13	9	9
/v/	14	14	10	10
/θ/	13	15	8	9
/ʃ/	11	11	4	9
/tʃ/	14	14	4	10
/dʒ/	15	13	5	10
/l/	15	13	7	10
/r/	15	15	9	11

A = Number of subjects correctly producing the /s/ phone in the syllable releasing position and preceed by each of 16 consonants.

B = Number of subjects correctly producing the /s/ phone in the syllable arresting position and followed by each of 16 consonants.

VITA

John Carlton Pennington was born in Johnson City, Tennessee, on November 18, 1953. He was graduated from Boones Creek High School in 1971. The following September, he entered East Tennessee State University in Johnson City, Tennessee, and in June, 1975, he recieved a Bachelor of Science degree in Speech and Hearing with a minor in Special Education.

In June, 1975, he enrolled in the Master's program in Speech Pathology at East Tennessee State University, and in September, 1975, he transferred to the Master's Program in Speech Pathology at the University of Tennessee at Knoxville. He received the degree of Master of Arts in Speech Pathology in December, 1977.

He was married to Paula Dian Roberts of Kingsport, Tennessee, on February 10, 1973, and is the father of one daughter, Leslie, who was born September 2, 1977.