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THE EFFECTS OF SYLLABLE RELEASING AND ARRESTING POSITIONS ON THE CORRECT ARTICULATION OF FIVE SELECTED PHONEMES

A Dissertation

Presented for the

Doctor of Philosophy

Degree

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ABSTRACT

The purposes of this study were: (1) To investigate the effects of syllable releasing and arresting positions on correct /s/, /z/, /ʃ/, /tʃ/ and /dʒ/ productions by articulatory defective children; and (2) to investigate the effects of varying phonetic contexts on correct productions of the five phonemes in syllable releasing and arresting positions by articulatory defective children.

Forty children 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 defective articulation. The speech stimuli used in this study were 34 different phonemes selected from the McDonald Picture Deep Test of Articulation: 17 items in which the phoneme (/s/, /z/, /ʃ/, /tʃ/ or /dʒ/) occurred in a syllable releasing position and 17 items in which the phoneme occurred in the syllable arresting position. After the child had practiced naming pairs of demonstration pictures, the phonemes were deep tested. All responses were judged as correct or incorrect by the investigator at the time of testing.

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

1. Children with articulatory defects produce significantly more correct /tʃ/ responses in the syllable releasing position and they produced significantly more correct /dʒ/ responses in the syllable arresting position.

2. Although children with articulatory defects produced on the average more correct /ʃ/ responses in the syllable releasing position than in the syllable arresting position, the difference was not significant.

3. Although children with articulatory defects produced on the average more correct /s/ and /z/ responses in the syllable arresting position than in the syllable releasing position, the difference was not significant.

4. Variability in correct phoneme production in articulatory defective children differs for each of the phonemes. That is, more variability in /s/, /z/ and /dʒ/ occurred in this study and less variability occurred in /ʃ/ and /tʃ/.

5. Different phonetic contexts appear to facilitate correct phoneme production in the syllable releasing position and in the syllable arresting position.

6. Further research is needed to provide more data on the effects of syllable positions and phonetic contexts on the responses of articulatory defective children.

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CHAPTER I

INTRODUCTION

Information about the learning of articulation has been accumulated from several areas of research (Winitz, 1977). Some investigators have developed models of the speech-motor-control system (Kozhevnikov and Chistovich, 1965; Henke, 1967; Liberman et al., 1967; Daniloff and Moll, 1968; MacNeilage, 1970).

Most models of the speech-motor-control system contain a definition of some basic production unit such as a phone or syllable sized unit (Henke, 1967). The syllable has been proposed by several investigators as the basic programmed unit of speech production (Kozhevnikov and Chistovich, 1965; Ohman, 1966; MacNeilage, 1970). Within a syllable, a phone or a speech sound functions to release (begin) or arrest (end) the syllable. How a sound functions within a syllable may affect the correct production of that sound (Scott and Milisen, 1954; McDonald, 1964; Zehel et al., 1972; Ingram, 1974b; Pennington, 1977). Most investigators who have assessed correct articulation as a function of position of a sound in a syllable (releasing or arresting position) have used normal speaking children as subjects (Zehel et al., 1972; Ingram, 1974b; Gallagher and Shriner, 1975a, 1975b); however, Pennington (1977) studied the correctness

of articulation as a function of position of a sound in a syllable in both articulatory defective and normal speaking children.

Differing phonetic contexts also have been reported to facilitate correct productions of various target phonemes in normal articulatory speakers and articulatory defective speakers (Curtis and Hardy, 1959; Fleming, 1972; Zehel et al., 1972; Hoffman et al., 1977). Pennington studied the relationship between syllable releasing and arresting positions and phonetic contexts on the number of correct productions of the /s/ phoneme. Such a relationship between syllable positions and phonetic contexts needs to be analyzed with regard to its influence on the number of correct productions using a variety of phonemes (McDonald, 1964; Zehel et al., 1972; Gallagher and Shriner, 1975b; Pennington, 1977).

This study was designed to investigate the influences of syllable releasing and arresting function and the influences of phonetic context on the number and percentage of correct productions of five selected phonemes by articulatory defective children. The information obtained from this study should add to the understanding of those factors of articulatory behavior which facilitate correct speech sound production in children with articulatory defects.

I. REVIEW OF THE LITERATURE

There are many variables related to articulatory acquisition. These variables can influence the correctness of production of a given sound. Such variables include the function of the sound in a syllable, i.e., whether it releases or arrests the syllable; the phonetic context in which the sound occurs; and the chronological age, intelligence, socioeconomic status, sex, motor skills and articulatory proficiency of the subject.

Function of the Sound in the Syllable

Numerous investigators in articulation learning have reported evidence which indicates that the function of the sound in the syllable may affect the correctness of production of that sound (Scott and Milisen, 1954; Templin, 1957; McDonald, 1964; Appleton, 1969; Fleming, 1972; Zehel et al., 1972; Ingram, 1974b; Winitz, 1975; Gallagher and Shriner, 1975a, 1975b; Pennington, 1977). The results and conclusions of some of these studies are summarized below.

The function of the sound in a syllable cannot necessarily be equated with the initial, medial, or final positions of that sound in a word. Initial and final positions of sounds only occur at the beginning and end of an utterance, while medial positions of sounds in words

can be either the syllable releasing or arresting position. In the studies by Scott and Milisen (1954), Templin (1957) and Sander (1972), single word responses were used. Thus the assumption that word initial consonants function to release the first syllable of a stimulus word and word final consonants serve to arrest the last syllable of a word seems logical. Scott and Milisen (1954) studied consonant production in 64 elementary school children. Consonants, in nonsense syllables and words, were produced correctly more often when they released the word or syllable (if one assumes the function of initial sounds in syllables is to release the syllable and that of the final sound in syllables is to arrest the syllable). Other investigators have reported similar results (Templin, 1957; Sander, 1972).

Appleton (1969) investigated the influence of phonetic context on /s/ and /r/ productions by five, six and seven-year-old normal articulatory children. The phonemes were deep tested in releasing and arresting syllable positions with varying adjacent phonetic contexts. Appleton reported significant differences in correct production of /s/ and /r/ in varying phonetic contexts. The function of the sound in the syllable was not reported. However, Pennington (1977) reviewed Appleton's data and reported that more correct /s/ productions occurred when the function of /s/ was to

arrest the syllable rather than to release it. These differences were not statistically significant.

Zehel et al. (1972) also studied the influence of phonetic context on /s/ productions by articulatory defective children ranging in age from five to 11 years. More correct productions of /s/ occurred when /s/ served to arrest the syllable rather than release it. Winitz (1975) interpreted these data to suggest that differences in the number of correct /s/ productions were due to right-to-left coarticulatory effects. That is, a phoneme which has not yet been uttered, will affect the pronunciation of a target phoneme which precedes it. Right-to-left coarticulation was also reported to occur in investigations by Gallagher and Shriner (1975a, 1975b). However, it is possible that correct productions may have been related to the releasing or arresting position of the sound within the syllable.

In 1964, McDonald hypothesized that releasing (initial) sounds in syllables may be easier to produce because they do not add to the syllable duration. Arresting (final) consonants add to the syllable duration. Furthermore, if a speaker increases his speaking rate, arresting consonants tend to shift to the releasing position in the following syllable where additional duration is not required. Appleton's and Zehel et al's., results do not support the hypothesis suggested by McDonald (1964).

Ingram (1974b) reported that 1-1/2 year old children learning phonological rules tend to acquire certain sounds according to their function in syllables. For example, in consonant-vowel-consonant (CVC) syllables, his subjects acquired velar consonants earlier in the arresting position. Labial consonants were acquired earlier in the releasing position. Ingram concluded that the arresting position in CVC syllables may be unmarked for back consonants and marked for front consonants. That is, the arresting position in CVC syllables may be less complex and more easily learned for back consonants than for front consonants. An unmarked relationship also may exist when the releasing consonant is more fronted than the arresting consonant. Due to the small sample size, Ingram suggested that his results provided only preliminary support for the hypothesis that children acquire certain sounds according to their function in syllables.

Pennington (1977) investigated the effects of syllable releasing and arresting positions on correct /s/ productions by five-year-old normal and articulatory defective speakers. He reported no significant difference between syllable positions (releasing or arresting) in the number of correct productions by the normal subjects. However, significant differences were reported between syllable releasing and arresting positions in

the articulatory defective group. These subjects correctly produced /s/ more often when /s/ functioned to arrest the syllable. Pennington also reported that differences varied as a function of the particular phonetic context in which /s/ occurred.

The results of investigations concerning syllable releasing and arresting positions on correct sound production are conflicting. Some researchers have reported that more correct sound productions occurred when the sound served to release the syllable (Scott and Milisen, 1954; Templin, 1957; McDonald, 1964). Other investigators reported the opposite trend; that is, more correct sound productions occurred when the sound served to arrest the syllable (Appleton, 1969; Zehel et al., 1972; Pennington, 1977). Thus, additional research is needed to specify whether particular sounds are correct more often when they release or arrest the syllable. Such research could be important in the clinical diagnosis and treatment of articulation disorders.

Phonetic Context

Many researchers have investigated the effects of phonetic context on speech sound production (McDonald, 1964; Daniloff and Moll, 1968; Winitz, 1975, 1977). In general, the results and conclusions can be summarized

as follows: (1) certain speech sounds, such as /r/, /s/ and /z/ are correctly produced more frequently in some phonetic contexts than in others (Curtis and Hardy, 1959; Gallagher and Shriner, 1975b; Hoffman et al., 1977; Pennington, 1977; and Stephens and Daniloff, 1977); (2) immediate or adjacent phonetic context has more influence on correct production of sounds than does broad phonetic context (McDonald, 1964; Daniloff and Moll, 1968; Zehel et al., 1972; Hoffman et al., 1977); (3) both consonant and vowel contexts influence correct production of sounds (Ohman, 1966; Zehel et al., 1972; Gallagher and Shriner, 1975a, 1975b); and (4) lexical constraints and syllable boundaries have minimal effects on phonetic influence in sound production (Daniloff and Moll, 1968; Hoffman et al., 1977).

Pennington (1977) studied the relationship between the effects of phonetic context and syllable releasing and arresting functions on the number of correct productions of the /s/ phoneme. He reported that the effects of phonetic context were not identical for the two syllable positions, releasing and arresting, in normal and articulatory defective five-year-old children. Pennington reported that the normal group had substantially fewer correct productions adjacent to /ʃ/. He also reported that articulatory defective children made significantly more correct /s/ productions in the

syllable arresting position when /s/ was adjacent to /p/, /d/, /g/, /ʃ/, /tʃ/, /dʒ/ or /l/. These phones were not, however, systematically similar in place of articulation, manner of articulation or voicing. Pennington's results were inconsistent with those reported by Gallagher and Shriner (1975a, 1975b) who reported that normal children made more correct /s/ productions when /s/ was followed by phones similar in place of articulation. Further research on the position of the sound in the syllable and the phonetic context in which the sound occurs is needed to identify the relationship between the two variables.

Chronological Age

Several investigators have reported that misarticulations in children decrease with age (Davis et al., 1931; Poole, 1934; Davis, 1938; Templin, 1957; Morency et al., 1967; Sander, 1972). Templin (1957) investigated the articulatory responses of 240 male and 240 female children, 30 of each sex at each of eight age levels from three to eight years. Items tested included single consonants, consonant blends, vowels and diphthongs. If a sound in a word was articulated correctly by 75 percent of the children in a given age level, it was considered mastered.

Sander (1972) reported ages of customary production of sounds; that is, when a child produces a given sound correctly more often than he misarticulates it or omits it, and included the average age of customary production. Sander also agreed that misarticulations decrease with age.

Appleton (1969) stated that the consistency of correct /r/ and /s/ productions by normal articulatory children increased uniformly as a function of age from five to seven years. This uniform increase was present for both syllable positions. The effects of syllable releasing and arresting position of speech sound production as a function of age has not been reported by investigators.

Intelligence

Several investigators have studied the relationship between intelligence and articulation for subjects of normal intelligence (Wellman et al., 1931; Williams, 1937; Reid, 1946; Yedinak, 1949; Schneiderman, 1955; Templin, 1957; Winitz, 1959). In general, all investigators reported a low positive relationship between articulation and intelligence. Winitz (1969) concluded that intelligence is a poor predictor of articulation and that intelligence may be of limited etiological importance in articulation disorders. However, the percentage of articulatory errors is greater for children

with intelligence quotients below 70 than for children with I.Q.'s above 70 (Bangs, 1942; Goodwin, 1955). Thus, the low, positive relationship between articulation and intelligence reported above was obtained from research on children within the normal range of intelligence and without organic and psychological involvements.

Socioeconomic Status

Socioeconomic status and sex are two cultural variables which have been related to articulatory acquisition and development. Socioeconomic status refers to socioeconomic class ratings, paternal occupation, or maternal education. Davis (1937) and Templin (1957) reported that a greater percentage of children with perfect articulation had parents who ranked in the upper occupational group than in the lower occupational group. However, Everhart (1956) reported no relationship between articulation and paternal occupation as measured by the Minnesota Scale of Paternal Occupations. Winitz (1959) also reported a nonsignificant correlation between articulation and socioeconomic status using the Warner, Meeker, Eells Index of Status Characteristics. Prins (1962a, 1962b) reported that articulatory defective children came from significantly lower socioeconomic circumstances than did a control group of children. In summary, children in lower socioeconomic groups have a greater number of articulation errors than children in

higher socioeconomic groups. However, when correlation indices are used, the relationship between articulation and socioeconomic status is low or nonsignificant. Winitz (1969) suggested that the relationship between articulation and socioeconomic status is about the same as the relationship between articulation and intelligence. Thus, Winitz concluded that intelligence and socioeconomic status are poor predictors of articulation and are limited in their importance as etiological factors in articulation disorders.

Sex

Sex differences in articulation behavior have been studied by several investigators (Wellman et al., 1931; Poole, 1934; Templin, 1957; Winitz and Lawrence, 1961). Small but significant differences between sexes in articulation skills were reported by Wellman et al. (1931), Koch (1956) and Winitz and Lawrence (1961). In studies with large numbers of subjects, significant differences between sexes were not obtained (Roe and Milisen, 1942; Wilson, 1954; Winitz, 1959). Winitz and Bellerose (1965) also reported nonsignificant differences between sexes in learning a non-English phoneme cluster. No explanations are available for the conflicting data on sex differences in articulatory behavior. Sex differences have not been significant in recent research

(Winitz, 1975). Winitz concluded that the speech environment experienced by American male and female children is very similar.

Motor Skills

The hypothesis that poor motor coordination is related to defective articulation has been tested by many investigators. In general, the results of these studies do not provide support for the hypothesis that articulatory defective children are slower on any specific measure of general motor ability (Mase, 1946; Reid, 1947; Prins, 1962a, 1962b). Oral and facial motor skill tests have been used to assess the motor ability of articulatory defective subjects. Such tests involve measurement of maximum muscle rate. The subject is asked to repeat a movement as rapidly as possible until told to stop.

Mase (1946) and Reid (1947) reported nonsignificant differences between normal speakers and articulatory defective speakers on such tasks as opening and closing the mouth, protruding the tongue, and lip rounding. Prins (1962a, 1962b) used graded series of diadochokinetic tests to compare three groups of articulatory defective children (omission, substitution, and interdentalization groups) and one normal group. On the monosyllabic tasks there were nonsignificant differences

between the articulatory defective and normal speakers. However the normal speakers produced significantly more responses on /pʌtʌ/ and /pʌtʌkʌ/ than did the articulatory defective children. Shelton et al. (1966) reported normal speakers performed significantly better on a tongue elevation task.

To summarize, those differences reported to be significant primarily involved measures of speech movements. Perhaps articulatory defective subjects are at a disadvantage in such tasks since they do not have a history of success with speech sound production. In order to test the hypothesis that articulatory defectiveness is due to some function of inferior motor ability, speech measures should be free of speech sound experience. Nonbehavioral neurological tests of the speech muscles or nerve innervation might remove such testing biases (Winitz, 1969).

Articulatory Proficiency

The developmental progression of speech sound acquisition has been investigated by many authors (Poole, 1934; Templin, 1957; Sander, 1972). Ingram (1974b) suggested that speech sound acquisition may be determined by the function of that sound in a syllable. That is, does the sound serve to release or arrest the syllable. To support his hypothesis, Ingram (1974b) reported that

velar consonants were acquired in the syllable arresting position earlier by 1-1/2 year old children while labial consonants were acquired earlier in the syllable releasing position. Such acquisition may be the result of a general phonological process governed by implicit phonological rules (Ingram, 1974b; Leonard, 1973).

Some children do not acquire adequately the phonological system of the adult's language (Winitz, 1969). The nature of defective articulation may be a less mature phonological system or an individual system with its own rules (Leonard, 1973). Whitacre et al. (1970) investigated the structure of the implicit phonological rule system in normal and articulatory defective children. The normal articulating group was more proficient than the articulatory defective group at discriminating possible from impossible phonetic combinations. The articulatory defective group also scored lower on tasks involving other linguistic areas such as form class and sentence structure. They concluded that the articulatory defective children had not acquired sufficiently the phonological aspects of the adult linguistic system.

Winitz and Lawrence (1961) studied the difference between six-year-old children with good articulation and those with poor articulation in learning non-English phonetic combinations. Both groups were equally capable

of learning to perform sound tasks of non-English phones. Since no differences were reported between the two groups, the authors concluded that learning factors prior to age six years may account for poor articulation development.

Winitz (1969, 1975) has speculated that articulation errors in children six to eight years of age are caused by deficiencies in learning experience. Articulation errors are learned word approximations that persist and become a self-contained phonemic system at variance with the adult phonemic system. The more the two systems are at variance, the more severe is the articulatory defectiveness of the child. Further analysis of normal and defective phonological systems appears to be necessary to identify those factors involved in the development of correct articulatory production.

Summary

This review of the literature on articulatory acquisition has revealed evidence that articulatory defective children use a phonological rule system which is either less developed or different from that utilized by normal articulating children (Leonard, 1973). Further research is necessary to identify those laws of articulatory behavior in normal speaking and articulatory defective children which govern correct articulation production.

The effects of phonetic contexts and syllable releasing and arresting positions on correct productions of the phoneme /s/ were reported by Gallagher and Shriner (1975a, 1975b) and Pennington (1977). From their results one can speculate that correct articulation production may be determined by such factors as the child's knowledge and use of the adult phonological system. Further, the effects of syllable position (releasing and arresting) on correct speech sound production may be a result of the phonological process at the syllable level (Ingram, 1974b; Winitz, 1975). Additional research is needed to identify further those factors responsible for the systematic occurrence of correct articulation.

One method of investigation is to determine if a relationship exists between the effects of syllable releasing and arresting positions and the effects of phonetic contexts with regard to their influence on correct production of a variety of phonemes (McDonald, 1964; Zehel et al., 1972; Pennington, 1977). Such research may contribute to the knowledge of those operations involved in correct articulation by articulatory defective speakers. Furthermore, by identifying the operations involved in correct articulation by defective speakers, improved intervention strategies for children with deviant articulatory patterns may be developed.

For example a specific syllable position for a given phoneme may facilitate a maximum number of correct responses. Such strategies may provide more effective planning and execution of behavioral goals in articulation therapy.

II. PURPOSE OF THE STUDY

The purpose of this study is to investigate the effects of syllable releasing and arresting position on the correct sound production of five selected phonemes produced by six-year-old articulatory defective speakers; and to investigate the effects of the varying phonetic contexts on the correct productions of the selected phonemes in syllable releasing and arresting positions. Specifically the main topics for study were as follows:

1. Differences between syllable releasing and syllable arresting positions in the mean number of correct productions of /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ made by six-year-old articulatory defective children.

2. Differences among the various consonant contexts on the mean number and percentage of correct productions of the following phonemes: /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ in the syllable releasing position.

3. Differences among the various consonant contexts on the mean number and percentage of correct

productions of the following phonemes: /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ in the syllable arresting position.

CHAPTER II

METHODS AND PROCEDURES

I. SUBJECTS

Criteria for Subject Selection

The subjects selected for this study were 40 six-year-old children with defective articulation. Subjects were selected from a local population of first grade students. The following criteria were used to select the subjects:

1. Chronological age (C.A.) within the range of six years zero months to six years 11 months as determined by birth-dates from school records;

2. Intelligence quotient of 85 or above as measured by the Peabody Picture Vocabulary Test;

3. No significant deviation in structure or function of the oral mechanism as determined by an oral peripheral examination given by the investigator;

4. Normal hearing acuity bilaterally as determined by a hearing screening at 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz at 25 dB (re. ANSI, 1969);

5. Maternal educational level at or above high school graduation as determined from parent interviews; and

6. Demonstration of defective articulation skills as determined by a score of 34 or below on the Templin-Darley Screening Test of Articulation (1960).

Speech Stimuli and Tasks

The five selected phonemes /s/, /z/, /ʃ/, /tʃ/ and /dʒ/ were combined with 34 different phonetic context items selected from the McDonald Picture Deep Test of Articulation (McDonald, 1964). The phonetic context items contained 17 consonants in the syllable releasing position and 17 consonants in the syllable arresting position. Each of the five selected phonemes occurred in either a syllable releasing or syllable arresting position with all of the 17 consonants. See Appendix A for an example of the speech stimuli.

Each subject was tested for the number of correct productions of /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ within each of the appropriate immediate phonetic contexts. For example, the stimulus words for /s/ in the syllable arresting and releasing positions were house and sun, respectively. The stimulus word house was produced in combination with 17 other words to obtain productions of /s/ in 17 different immediate phonetic contexts in the syllable arresting position (Appendix A). The same procedure was followed with the stimulus word sun. Procedures for administration were those suggested by McDonald (1964).

The five phonemes used in this study were selected to represent five frequently misarticulated phonemes in the English language. The /s/ and /z/ and /ʧ/ and /ʤ/ cognates are similar in manner and place features of articulation but differ in the voicing feature. The fifth phoneme /ʃ/, a frequently misarticulated sound, was not matched with its voiced cognate /ʒ/ due to the infrequent use of the latter in the English language.

II. PROCEDURES

Subject Screening

Subjects were individually screened at their schools prior to participation in this study. During screening and testing, the investigator and the subject were seated at a small table next to each other in a room which was as quiet and as distraction-free as possible. The screening procedures took approximately 40 minutes. The order of screening test administration was: the Peabody Picture Vocabulary Test, the Templin-Darley Screening Test of Articulation, the hearing screening, and the oral peripheral examination. See Appendix B for screening results.

Subject Testing

After the subject successfully completed the screening procedure, the McDonald Picture Deep Test of

Articulation was administered for the phonemes /s/, /z/, /ʃ/, /tʃ/, and /dʒ/. The testing procedure took approximately 30 minutes. All responses were recorded on a Sony Tape Recorder (Model TC 142) with a Sony EMC Microphone (Model 19B). All responses were judged as correct or incorrect by the investigator at the time of testing.

The tape recordings of all subjects on all tasks were edited to eliminate any extraneous speech from the investigator and subjects. Several utterances from each subject were retaped on a Sony Tape Recorder (Model TC 377). For task accomplishment reliability, a panel of three ASHA certified speech pathologists listened to the edited tape recording (Sony Tape Recorder, Model TC 377; Ampex Amplifier-Speaker, Model H 1328). The panel rated responses as to whether or not each subject named the two words without pausing between them as McDonald instructed in the McDonald Picture Deep Test of Articulation (1964).

The obtained data were used in computing task accomplishment reliability using the formula:

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

where A equals the number of agreements and D equals the number of disagreements. The percent agreement between Panelist 1 and the investigator was 95 percent. Percent agreement between Panelist 2 and the investigator was

96 percent. With Panelist 3 and the investigator, the percent agreement was 91 percent. This index of task accomplishment reliability was considered adequate for the purposes of the present research.

CHAPTER III

RESULTS

Forty subjects, all with defective articulation, each produced 34 selected context items for the /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ (17 responses for each consonant in a syllable releasing position and 17 responses for each consonant in a syllable arresting position for each of the five phonemes). The total number of responses per subject was 170 with a range of correct responses in each syllable position from 0 to 17. The total number of responses for all subjects was 6,800. The criterion measure used in this study was the number of correct responses for each subject in releasing and arresting syllable position.

I. RELIABILITY

An ASHA certified speech pathologist independently judged the responses of three subjects at the time of testing with the investigator. Two weeks following the initial testing procedure, these subjects were retested and their responses judged again by the investigator and the same speech pathologist. Before judging the responses, the speech pathologist was instructed to listen to each subject's responses as many times as necessary to make the most accurate judgment about the correctness or

incorrectness of phoneme production. The obtained data were used in computing intra- and interjudge reliability using the percent agreement formula presented in Chapter II. Appendix C presents a summary of intra- and interjudge percent agreement scores.

Intrajudge Reliability

Intrajudge reliability was determined for the investigator (Judge 1) and the speech pathologist (Judge 2) independently by computing percent agreement scores between the two test sessions; i.e., between the initial test session and the session two weeks later. Agreement between test sessions was 93 percent and 92 percent for Judge 1 and Judge 2, respectively. These indices of reliability are in agreement with those reported by Pennington (1977) and Hill (1973) for similar response judgments.

Interjudge Reliability

The judged responses obtained during the initial testing procedure by Judge 1 and Judge 2 were used to compute agreement scores between judges. Agreement between Judges 1 and 2 was 92 percent. This index of reliability is in agreement with those reported by Pennington (1977) and Appleton (1969).

Intrasubject Reliability

Ten subjects were recalled two weeks after the initial testing date and asked to repeat 10 items randomly selected by the investigator. The percent agreement for the two testing sessions for the investigator was 93 percent. This index of reliability was considered adequate for the purposes of the present research.

II. STATISTICAL ANALYSIS

Table 1 presents a summary of the means, medians, ranges and standard deviations for all phonemes used in this investigation. For example, the range of correct responses for syllable releasing position for the phoneme /s/, for all subjects, was from 2 to 17, with a mean of 12.85 and a median score of 15. In the syllable arresting position for the phoneme /s/, the range was from 1 to 17, with a mean of 13.15 and a median score of 16.

A two-factor with repeated-measures on both factors analysis of variance design was used to analyze differences among the target phonemes (/s/, /z/, /ʃ/, /tʃ/, and /dʒ/), and differences between the two syllable positions (releasing and arresting), and the interaction between target phonemes and syllable positions. The results of the analysis of variance are presented in Table 2.

Table 1. Means, medians (Mdn.), standard deviations (S.D.), and ranges of subjects' correct responses in syllable releasing and arresting positions and the overall means ($\bar{X}$) for each phoneme and for each position.

Releasing Position		Phonemes	Arresting Position	
Mean	12.85	/s/	Mean	13.15
Mdn.	15.00	$\bar{X}$ = 13.00	Mdn.	16.00
S.D.	5.44		S.D.	5.42
Range	2-17		Range	1-17
Mean	9.55	/z/	Mean	10.70
Mdn.	11.00	$\bar{X}$ = 10.13	Mdn.	12.00
S.D.	6.44		S.D.	5.31
Range	0-17		Range	0-17
Mean	14.80	/ʃ/	Mean	14.15
Mdn.	16.00	$\bar{X}$ = 14.47	Mdn.	12.00
S.D.	4.18		S.D.	4.26
Range	0-17		Range	0-17
Mean	16.58	/tʃ/	Mean	15.95
Mdn.	17.00	$\bar{X}$ = 16.27	Mdn.	17.00
S.D.	1.17		S.D.	1.75
Range	10-17		Range	9-17
Mean	12.35	/dʒ/	Mean	15.25
Mdn.	16.00	$\bar{X}$ = 13.80	Mdn.	16.00
S.D.	6.56		S.D.	3.30
Range	0-17		Range	2-17
$\bar{X}$ = 13.23			$\bar{X}$ = 13.82	

Table 2. Summary of analysis of variance for evaluating differences between selected phonemes (/s/, /z/, /ʃ/, /tʃ/, /dʒ/) and syllable positions (releasing and arresting).

Source	SS	df	ms	F*	p**
Total	10,516.00	399	--	---	--
Subjects	1,737.60	39	--	---	--
Phonemes (P)	1,610.71	4	402.68	13.37	.001
Syllable (SP) Positions	36.61	1	36.61	2.27	NS
P X SP	183.87	4	45.97	4.42	.05
$Error_P$	4,697.99	156	30.12	---	--
$Error_{SP}$	628.99	39	16.12	---	--
$Error_{P \times SP}$	1,620.23	156	10.39	---	--

*F rations: ms_P/ms_{error_P}; $ms_{SP}/ms_{error_{SP}}$; $ms_{P \times SP}/ms_{error_{P \times SP}}$.

**Level of significance.

A review of Table 2 reveals the following: (1) The mean number of correct responses differed significantly on productions of /s/, /z/, /ʃ/, /tʃ/ or /dʒ/ ($F = 13.37$, $df = 4/156$, $p < 0.001$); (2) syllable releasing and arresting positions were not significantly different ($F = 2.27$, $df = 1/39$, $p < 0.200$); and (3) the interaction between target phonemes and syllable positions was significant ($F = 4.42$, $df = 4/156$, $p < 0.05$), indicating that the correct number of productions was different for each target phoneme for the two syllable positions. These differences are presented graphically in Figure 1.

An analysis of Figure 1 reveals that the means of correct responses differ in syllable releasing and arresting positions for each phoneme. The mean number of correct responses in the arresting position are slightly higher for /s/ and /z/ (differences of .30 and 1.15, respectively) and much higher for /dʒ/ (difference of 2.90). The mean number of correct responses in the syllable releasing position are slightly higher for /ʃ/ and /tʃ/ (differences of 0.75 and 0.63, respectively).

Differences Between Syllable Releasing and Syllable Arresting Means for Five Phonemes

Because of the significant interaction indicating that the effects of syllable releasing and arresting position were different among the five selected phonemes,

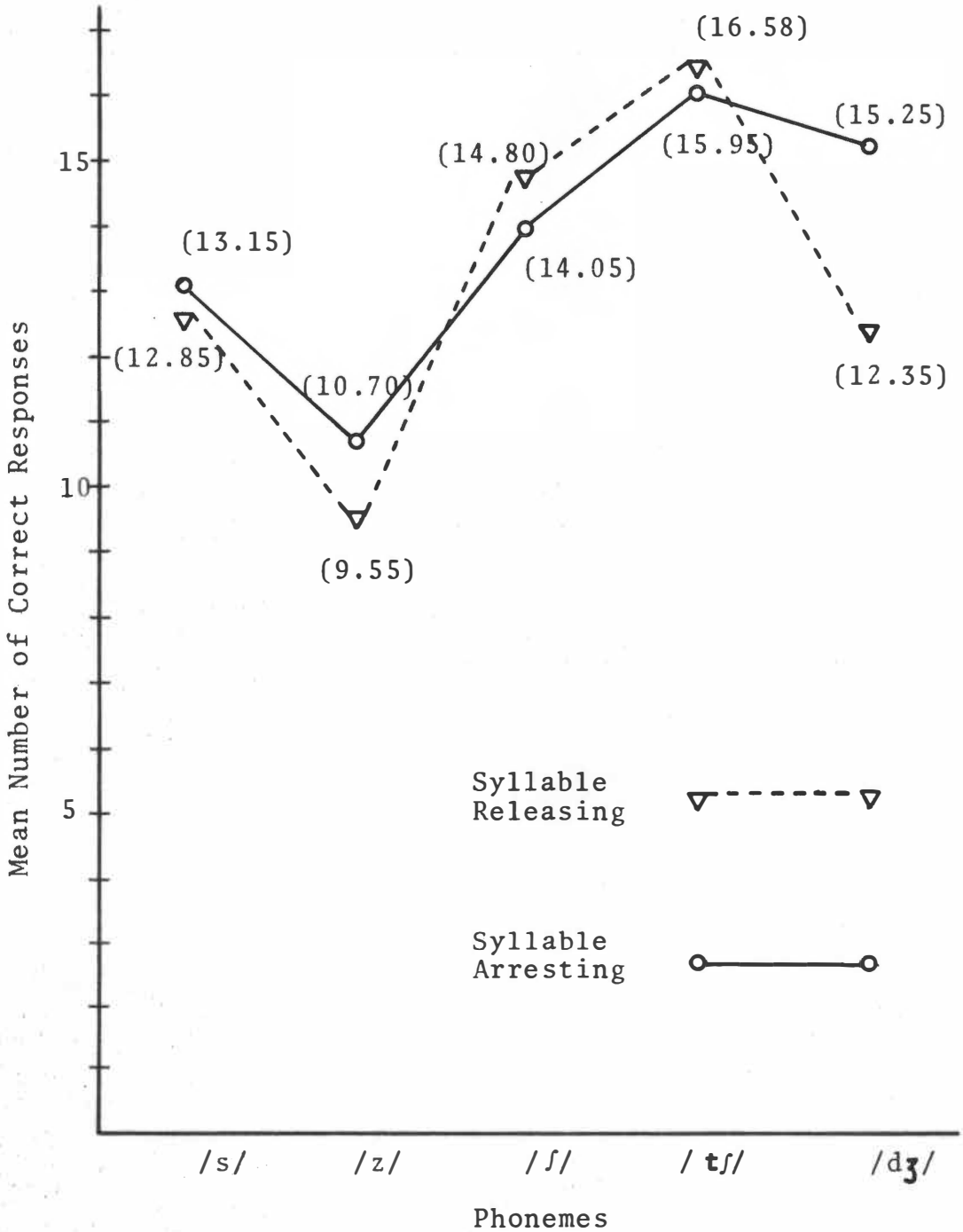

Figure 1. Mean number of correct responses in 17 syllable releasing and 17 syllable arresting positions for the five phonemes.

five treatment-by-subjects analyses of variance, using a repeated-measures design, were used to assess the differences between the two syllable positions for each phoneme. The results of these tests are summarized in Table 3. The mean number of correct /tʃ/ responses was significantly higher in the syllable releasing position than in the syllable arresting position ($F = 4.56$, $df = 1/39$, $p < 0.05$). The mean number of correct /dʒ/ responses was significantly higher in the syllable arresting position than in the syllable releasing position ($F = 10.63$, $df = 1/39$, $p < 0.005$). The two significant results occurred in both syllable positions, i.e., /tʃ/ responses were significantly greater in the syllable releasing position and /dʒ/ responses were significantly greater in the syllable arresting position.

Differences Between Means among Phonemes in Both the Syllable Releasing and Arresting Positions

Because of the significant interaction in the two-factor analysis of variance indicating the effects of phonemes were different for the two syllable positions, two treatment-by-subjects analyses of variance, one for each position, were used to assess the differences between phonemes in the syllable releasing position and in the syllable arresting position. The results of these analyses are summarized in Table 4. The Scheffé Test for differences among several means was used to

Table 3. Summary of analysis of variance for evaluating differences between syllable releasing and arresting positions (P) for each of five phonemes.

Phonemes	Source	SS	df	ms	F*	p**
/s/	Total	2,306.99	79	--	--	--
	Subjects (S)	2,094.49	39	--	--	--
	Positions (P)	1.52	1	1.52	0.28	NS
	Error	210.98	39	5.41	--	--
/z/	Total	2,742.75	79	--	--	--
	Subjects (S)	1,946.75	39	--	--	--
	Positions (P)	26.45	1	26.45	1.34	NS
	Error	769.55	39	19.73	--	--
/ʃ/	Total	1,401.55	79	--	--	--
	Subjects (S)	1,282.55	39	--	--	--
	Positions (P)	11.25	1	11.25	4.08	.05
	Error	107.75	39	2.76	--	--
/tʃ/	Total	181.00	79	--	--	--
	Subjects (S)	112.00	39	--	--	--
	Positions (P)	7.20	1	7.20	4.56	.05
	Error	61.80	39	1.58	--	--
/dʒ/	Total	2,272.80	79	--	--	--
	Subjects (S)	1,459.80	39	--	--	--
	Positions (P)	174.50	1	174.50	10.63	.005
	Error	638.95	39	16.38	--	--

*F rations: ms_P/ms_{error}

**Level of significance.

Table 4. Summary of analysis of variance for evaluating differences among phonemes (P) for the syllable releasing position and the syllable arresting position.

Source	SS	df	ms	F*	p**
		Releasing Position			
Total	6,302.32	199	--	--	--
Subjects (S)	1,305.12	39	--	--	--
Phonemes (P)	1,118.97	4	279.74	11.25	0.005
Error	3,878.23	156	24.86	--	--
		Arresting Position			
Total	4,176.87	199	--	--	--
Subjects (S)	2,057.47	39	--	--	--
Phonemes (P)	675.60	4	168.90	18.24	0.001
Error	1,443.80	156	9.26	--	--

*F rations: ms_P/ms_{error}

**Level of significance.

assess the differences among means in the syllable releasing position and in the syllable arresting position. The computational formula for computing the critical difference (C. Diff.) is:

$$\text{C. Diff.} = \sqrt{(a-1)F_{dfa-1\Delta f\ error}} \sqrt{\frac{2ms_{within\ grp.\ error}}{n\ (per\ grp.)}};$$

where "a" is equal to the number of groups to be compared, F is the tabled F value for the appropriate df, ms within group error is equal to the interaction error term, and "n" is equal to 40 subjects. The critical difference was 3.42, and four of the 10 possible pairs in the syllable releasing position were significantly different. The significant and nonsignificant pairs are shown in Table 5.

The results of the second treatment-by-subjects analysis of variance are also summarized in Table 4. The Scheffé Test for differences among several means was used to compare the significance of the differences between the 10 pairs of means in the syllable arresting position for all five phonemes. The same computational formula presented above was used. The critical difference was 2.09, and six of the 10 possible pairs in the syllable arresting position were significantly different. The significant and nonsignificant pairs are shown in Table 5.

Table 5. Difference among the pairs of the mean number of correct responses for the five phonemes in syllable releasing and syllable arresting position.

Releasing Position (C. Diff. = 3.42)**	Phoneme Pairs	Arresting Position (C. Diff. = 2.09)**
3.30	/s/ - /z/	2.98*
1.95	/s/ - /ʃ/	0.90
3.73*	/s/ - /tʃ/	2.80*
0.50	/s/ - /dʒ/	2.10*
5.25*	/z/ - /ʃ/	3.88*
7.03*	/z/ - /tʃ/	5.78*
2.80	/z/ - /dʒ/	5.08*
1.78	/ʃ/ - /tʃ/	1.90
2.45	/ʃ/ - /dʒ/	1.20
4.23*	/tʃ/ - /dʒ/	0.70

*Significant pairwise differences ($\alpha = 0.05$).

**Critical difference used to assess the differences among means in the syllable releasing and syllable arresting position.

III. DIFFERENCES IN PHONETIC CONTEXT ON CORRECT PRODUCTIONS OF FIVE SELECTED PHONEMES

The effects of phonetic context on correct productions of syllable releasing and arresting positions for each of the five phonemes were evaluated according to preceding consonants in the syllable releasing position and following consonants in the syllable arresting position. The raw data containing the number and percentage of correct responses by all 40 subjects, for each phoneme are tabled and illustrated in Appendix D.

Differences in Phonetic Context for /s/

The number and mean percentage of correct responses of /s/ productions by all subjects are presented in Appendix D. In the syllable releasing position, the consonants /p/ and /l/ preceded the most correct responses of /s/. These two consonants are not similar in place, manner, or voicing features. The /p/ and /s/ are both voiceless phones. The phone preceding the least number of correct /s/ responses was the fricative /ʃ/ which has the common feature of manner of production with the target phoneme /s/.

To describe the correct responses of /s/ in the syllable releasing position in more detail, the number and percentage of correct /s/ responses were calculated according to the manner of production, place of production

and voicing of the preceding consonant. These data are presented in Table 6 and Figure 2. Liquids and stop plosives preceded the highest percentage of correct /s/ responses (78.8 percent for liquids and 77.1 percent for stop plosives). Fricative and affricate phonemes were associated with the lowest percentage of correct /s/ responses (71.5 percent for fricatives and 71.3 percent for affricates).

Place of production for consonants preceding /s/ are illustrated in Figure 3. In place of production, bilabial and velar consonants preceded the highest percentage of correct /s/ productions with 80.0 percent and 78.0 percent, respectively. Palatal consonants preceded the lowest percentage of correct /s/ productions with 68.0 percent.

Voicing features are also presented in Table 6 and in Figure 4. The percentage of correct responses of /s/, when the preceding consonant was voiced, was 76.0 percent and when the preceding consonant was voiceless was 73.0 percent.

The number and mean percentage of correct /s/ productions in the syllable arresting position are presented in Appendix D. Unlike the syllable releasing position, /ʃ/ followed the most correct /s/ responses rather than the least correct /s/ responses. In Table 6 and Figures 2, 3, and 4, the correct /s/ responses are presented according to manner, place and voicing features of following

Table 6. Number of phonemes (N), correct and total responses (C/T), mean percent correct (%) and standard deviation (SD) of /s/ responses for preceding consonants (PC) in syllable releasing position and for following consonants (FC) in syllable arresting position classified according to manner, place and voicing of production.

Syllable Releasing Position					Syllable Arresting Position				
PC	N	C/T	%	SD	FC	N	C/T	%	SD
				Manner of Production					
Stop Plosives	6	185/240	77.1	6.12	Stop Plosives	6	184/240	76.7	5.87
Nasals	2	59/80	73.8	1.41	Nasals	3	63/80	78.8	1.41
Fricatives	5	143/200	71.5	7.44	Fricatives	5	156/200	78.0	5.40
Affricates	2	57/80	71.3	2.12	Affricates	2	63/80	78.8	5.66
Liquids	2	63/80	78.8	12.43	Liquids	2	61/80	76.3	4.95
				Place of Production					
Bilabials	3	96/120	80.0	2.65	Bilabials	3	96/120	80.0	1.73
Labiodental	2	59/80	73.8	0.71	Labiodental	2	59/80	73.8	2.12
Linguadental	1	28/40	70.0	--	Linguadental	1	32/40	80.0	--
Alveolar	6	183/240	76.3	2.59	Alveolar	6	180/240	75.0	2.00
Palatal	3	81/120	67.5	2.65	Palatal	3	97/120	80.8	2.08
Velar	2	62/80	77.5	0.00	Velar	2	63/80	78.8	0.71
				Voicing of Production					
Voiced	10	303/400	75.8	2.06	Voiced	10	308/280	77.0	1.69
Voiceless	7	204/280	72.9	3.39	Voiceless	7	219/280	78.2	2.36

Figure 2. Percentages of correct responses of five phonemes (/s/, /z/, /ʃ/, /tʃ/, /dʒ/) according to preceding consonants in the syllable releasing position and following consonants in the syllable arresting position for manner of production.

A. Phoneme /s/.

B. Phoneme /z/.

C. Phoneme /ʃ/.

D. Phoneme /tʃ/.

E. Phoneme /dʒ/.

Key: Aff. = Affricates, F. = Fricatives, Liq. = Liquids, N. = Nasals, S.P. = Stop Plosives.

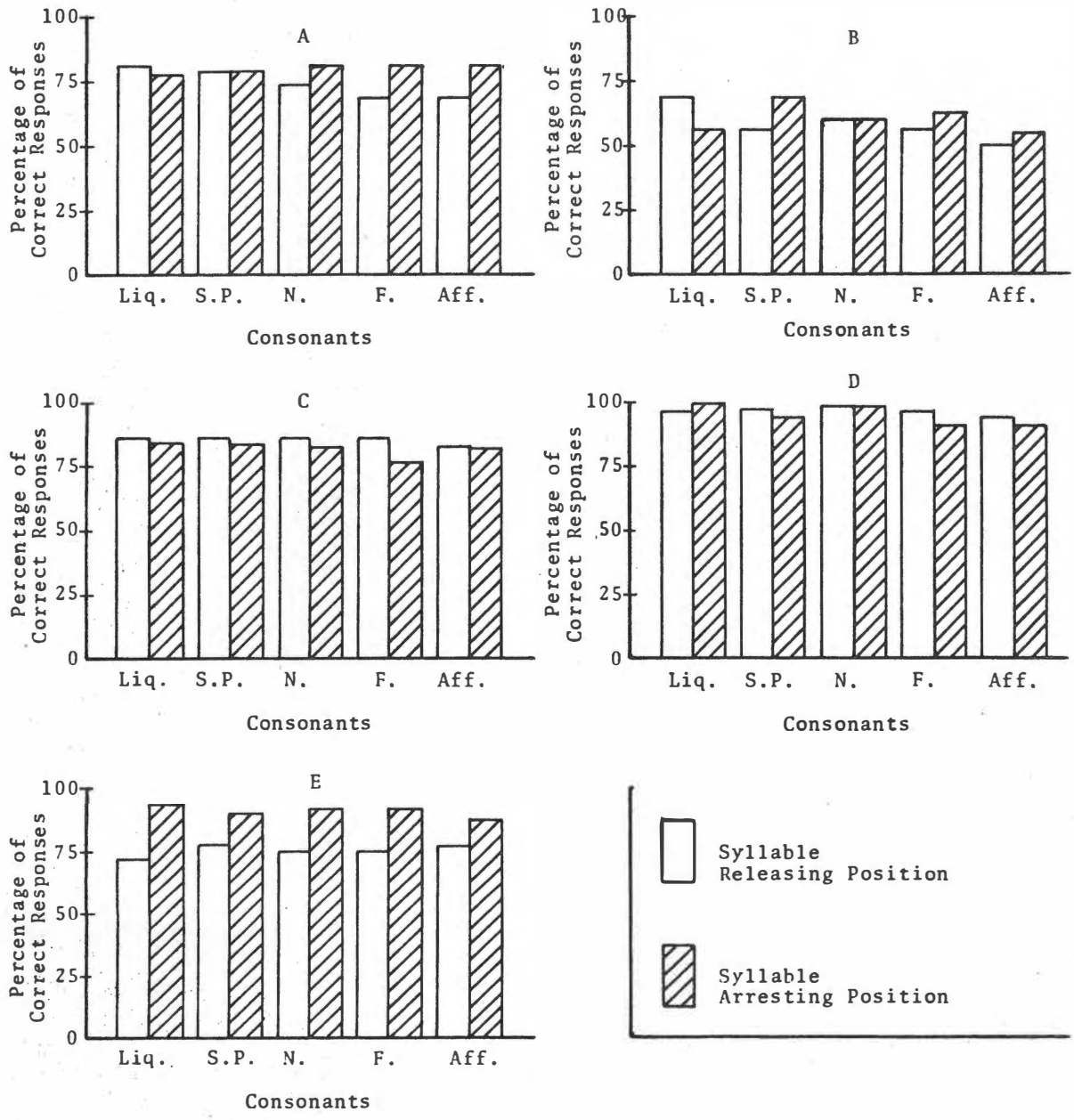
A
B
C
D
E
Percentage of Correct Responses
100
75
50
25
0
Liq.
S.P.
N.
F.
Aff.
Consonants
Syllable Releasing Position
Syllable Arresting Position

Figure 2

Figure 3. Percentages of correct responses of five phonemes (/s/, /z/, /ʃ/, /tʃ/, /dʒ/) according to preceding consonants in the syllable releasing position and following consonants in the syllable arresting position for place of production.

A. Phoneme /s/.

B. Phoneme /z/.

C. Phoneme /ʃ/.

D. Phoneme /tʃ/.

E. Phoneme /dʒ/.

Key: A. = Alveolars, B. = Bilabials, Lab. = Labiodentals, Lin. = Linguadental, P. = Palatal, V. = Velars.

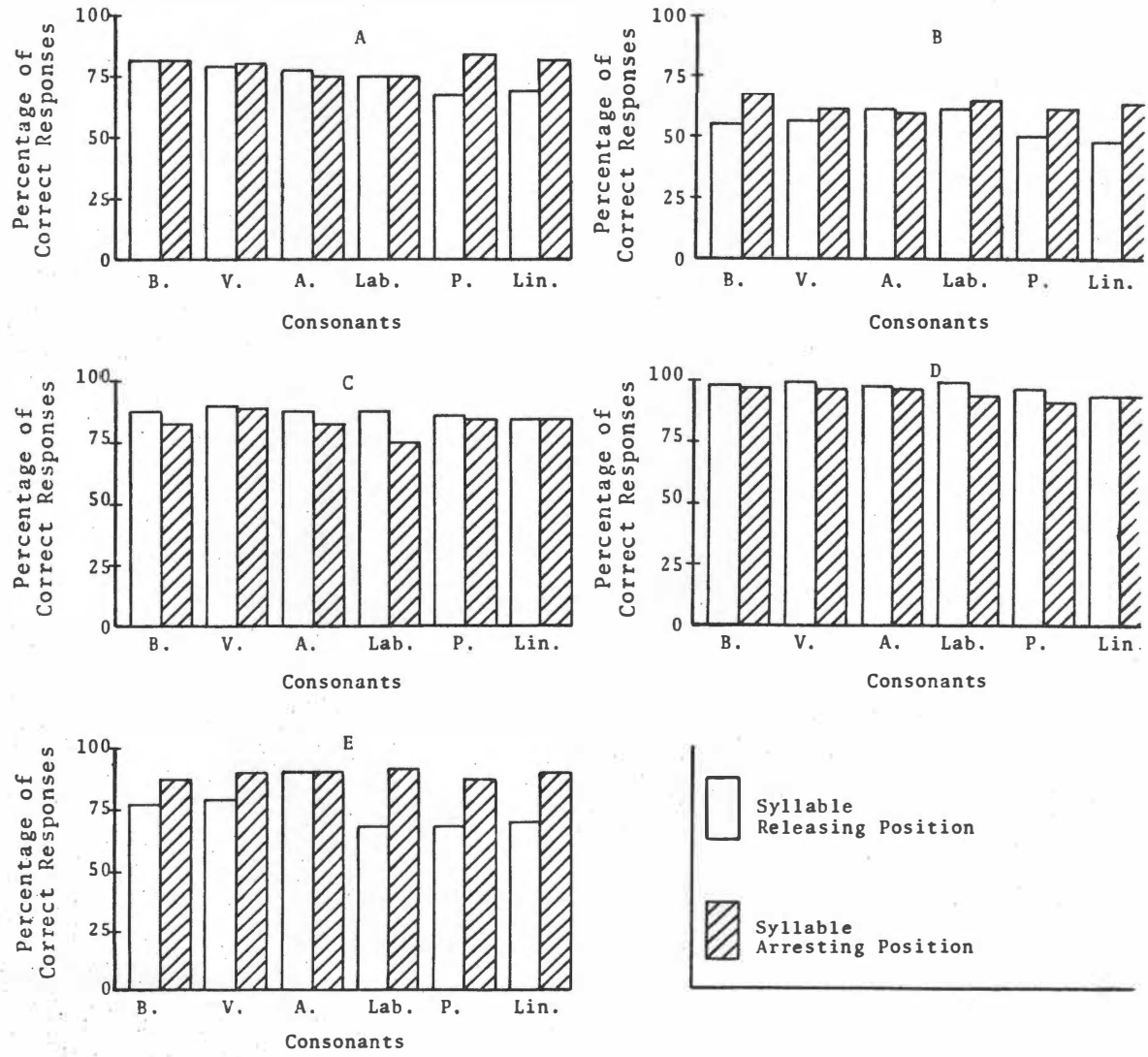
A
B
C
D
E
Percentage of Correct Responses
100
75
50
25
0
B.
V.
A.
Lab.
P.
Lin.
Consonants
Syllable Releasing Position
Syllable Arresting Position

Figure 3

Figure 4. Percentages of correct responses of five phonemes (/s/, /z/, /ʃ/, /tʃ/, /dʒ/) according to preceding consonants in the syllable releasing position and following consonants in the syllable arresting position for voicing of production.

A. Phoneme /s/.

B. Phoneme /z/.

C. Phoneme /ʃ/.

D. Phoneme /tʃ/.

E. Phoneme /dʒ/.

Key: V. = Voiced, v. = Voiceless.

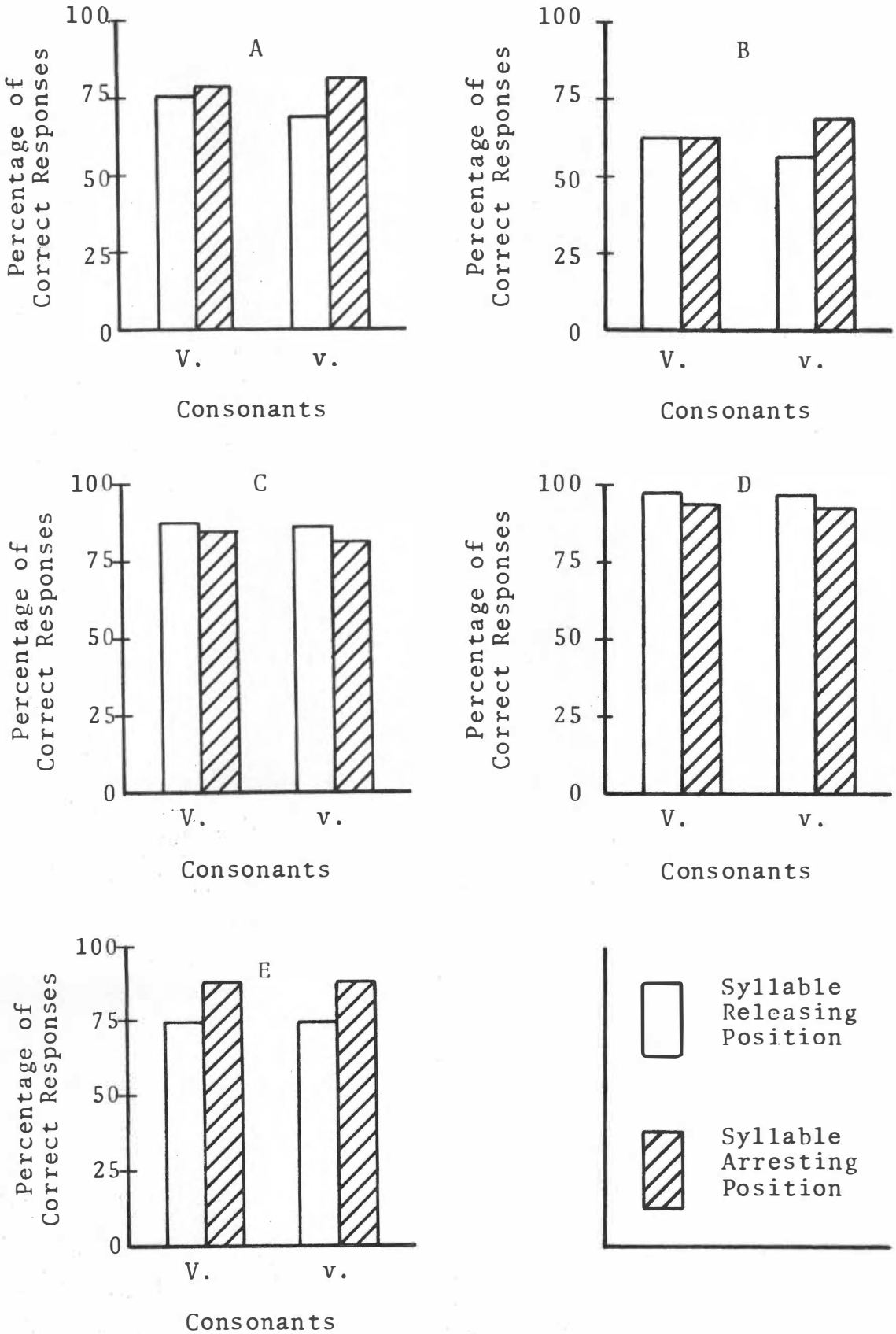
A
B
C
D
E
100
75
50
25
0
Percentage of Correct Responses
V.
v.
Consonants
Syllable Releasing Position
Syllable Arresting Position

Figure 4

consonants in the syllable arresting position. In manner of production, nasals and affricates followed the highest percentage of correct /s/ responses (78.8 percent for nasals and affricates). Liquids followed the lowest percentage of correct /s/ responses (76.3 percent). In place of production, palatal consonants followed 80.8 percent correct /s/ responses, the highest percentage of correct responses. Labiodental consonants followed the lowest percentage of correct /s/ responses at 73.8 percent. The percentage of correct /s/ responses, when the following consonant was voiced was 77.0 percent and when the following consonant was voiceless was 78.2 percent. Reviewing Table 6 and Figures 2, 3, and 4, only small differences in syllable releasing and arresting positions were reported for /s/ in manner, place and voicing features of production.

Differences in Phonetic Context for /z/

The number of correct responses and the mean percentage of correct /z/ productions, according to the preceding consonant in the syllable releasing position, are listed in Appendix D. In the syllable releasing position, the most correct /z/ productions were preceded by the liquids /l/ and /r/. These consonants are similar in voicing and manner of production. They are similar to /z/ in voicing of production. The least correct /z/

productions were preceded by /θ/ and /tʃ/. These consonants are similar in voicing of production. They are not similar to /z/ in voicing of production. The consonant /θ/ is similar to /z/ in manner of production and the consonant /tʃ/ is similar to /z/ in place of production.

The features of manner, place and voicing are presented with correct /z/ responses in Table 7 and illustrated in Figures 2, 3, and 4. In manner of production, the liquids preceded the highest percentage of correct /z/ responses (70.0 percent). The affricates preceded the lowest percentage of correct /z/ responses (48.8 percent). In place of production, alveolar consonants preceded the highest percentage of correct /z/ responses (62.9 percent). The linguadental consonant /θ/ preceded the lowest percentage of correct /z/ responses (45.0 percent). Voiced consonants preceded more correct /z/ productions at 60.6 percent. Voiceless consonants preceded 53.8 percent correct /z/ responses.

Stop plosive consonants followed the highest percentage of correct /z/ productions in the syllable arresting position at 68.3 percent (see Table 7). The affricate consonants followed the lowest percentage of correct /z/ productions at 55.0 percent. Consonants organized according to the place of production followed a range of 57.5 percent to 68.3 percent of correct /z/ responses. Bilabial consonants followed 68.3 percent of

Table 7. Number of phonemes (N), correct and total responses (C/T), mean percent correct (%) and standard deviation (SD) of /z/ responses for preceding consonants (PC) in syllable releasing position and for following consonants (FC) in syllable arresting position classified according to manner, place and voicing of production.

Syllable Releasing Position					Syllable Arresting Position				
PC	N	C/T	%	SD	FC	N	C/T	%	SD
				Manner of Production					
Stop Plosives	6	134/240	55.8	1.37	Stop Plosives	6	162/240	67.5	2.53
Nasals	2	47/80	58.8	0.71	Nasals	2	47/80	58.8	0.71
Fricatives	5	114/200	57.0	3.27	Fricatives	5	122/200	61.0	2.61
Affricates	2	39/80	48.8	2.12	Affricates	2	44/80	55.0	2.83
Liquids	2	56/80	70.0	2.83	Liquids	2	45/80	56.3	0.71
				Place of Production					
Bilabials	3	66/120	55.0	1.73	Bilabial	3	82/120	68.3	3.51
Labiodental	2	50/80	62.5	1.41	Labiodental	2	52/80	65.0	1.41
Linguadental	1	18/40	45.0	--	Linguadental	1	25/40	62.5	--
Alveolar	6	151/240	62.9	2.71	Alveolar	6	149/240	62.1	2.40
Palatal	3	60/120	50.0	1.73	Palatal	3	69/120	57.5	2.65
Velar	2	45/80	56.3	0.71	Velar	2	50/80	62.5	2.83
				Voicing of Production					
Voiced	9	218/360	60.6	2.73	Voiced	9	220/360	61.1	2.01
Voiceless	8	172/320	53.8	2.73	Voiceless	8	207/320	64.7	3.09

correct /z/ responses. Palatal consonants followed 57.5 percent of correct /z/ responses. Voiced consonants followed 61.1 percent of correct /z/ responses. Voiceless consonants followed 64.7 percent of correct /z/ responses. This was contrary to correct arresting /s/ responses and correct releasing /z/ and /s/ responses.

Differences in Phonetic Context for /ʃ/

In all phonetic contexts, except for /ʧ/ and /d/, the phoneme /ʃ/ was more frequently produced correctly in the syllable releasing position rather than in the syllable arresting position. These data are listed in Appendix D. In the syllable releasing position, the percentage of correct responses ranged from 83.0 to 93.0 percent for all the phonetic environments. In the syllable arresting position, the percentage of correct responses ranged from 73.0 to 88.0 percent for all phonetic environments. The /t/ and /v/ consonants preceded the highest percentage of correct /ʃ/ productions. The /t/ and /v/ are not similar in place or manner of production but the /v/ and /ʃ/ are similar in manner of production. The /d/, /g/, and /n/ followed the highest percentage of correct /ʃ/ productions in the syllable arresting position. The /d/ and /g/, both stop plosives, are similar in manner of production. The /d/ and /n/ are similar in place of production. These phones are not similar to /ʃ/ in manner or place of production.

Table 8 and Figures 2, 3, and 4 (pages 40, 42, and 44, respectively) list the number and percentage of correct /ʃ/ responses in the syllable releasing position according to the manner, place and voicing of preceding consonants. In manner of production, stop plosive and liquid consonants preceded the highest percentage of correct /ʃ/ responses (87.9 percent and 87.5 percent, respectively). The affricate consonants preceded the lowest percentage of correct /ʃ/ responses at 83.8 percent. The range from highest to lowest percentage of correct /ʃ/ responses was only 4 percentage points with regard to manner of production. Table 8 also lists the six places of production of consonants preceding /ʃ/ in the syllable releasing position. Velar consonants preceded the highest percentage of correct /ʃ/ responses at 90.0 percent. The linguadental consonant /θ/ preceded the lowest percentage of correct /ʃ/ responses at 82.5 percent. The /θ/ is the only linguadental consonant in this study. Voiced consonants preceded 87.0 percent of correct /ʃ/ responses. Voiceless consonants preceded 86.1 percent of correct /ʃ/ responses.

Manner, place and voicing of production of following consonants are also listed in Table 8 for the syllable arresting position. As in the syllable releasing position, liquid consonants followed the highest percentage of correct /ʃ/ responses at 85.0 percent. Fricative

Table 8. Number of phonemes (N), correct and total responses (C/T), mean percent correct (%) and standard deviation (SD) of /ʃ/ responses for preceding consonants (PC) in syllable releasing position and for following consonants (FC) in syllable arresting position classified according to manner, place and voicing of production.

Syllable Releasing Position					Syllable Arresting Position				
PC	N	C/T	%	SD	FC	N	C/T	%	SD
				Manner of Production					
Stop Plosives	6	211/240	87.9	1.33	Stop Plosives	6	202/240	84.2	1.63
Nasals	2	69/80	86.3	0.71	Nasals	2	67/80	83.8	2.12
Fricatives	5	172/200	86.0	1.14	Fricatives	5	154/200	77.0	1.79
Affricates	2	67/80	83.8	0.71	Affricates	2	66/80	82.5	1.41
Liquids	2	70/80	87.5	0.00	Liquids	2	68/80	85.0	0.00
				Place of Production					
Bilabials	3	104/120	86.7	0.58	Bilabials	3	98/120	81.7	2.08
Labiodental	2	70/80	87.5	1.41	Labiodental	2	61/80	76.3	2.12
Linguadental	1	33/40	82.5	--	Linguadental	1	33/80	82.5	--
Alveolar	7	243/280	86.8	0.95	Alveolar	7	231/280	82.5	2.24
Palatal	2	67/80	83.8	0.71	Palatal	2	66/80	82.5	1.41
Velar	2	72/80	90.0	1.41	Velar	2	68/80	85.0	1.41
				Voicing of Production					
Voiced	10	348/400	87.0	1.14	Voiced	10	335/400	83.8	1.58
Voiceless	7	241/280	86.1	1.13	Voiceless	7	222/280	79.3	2.06

consonants followed the lowest percentage of correct /ʃ/ responses at 77.0 percent (the least correct /ʃ/ responses were followed by fricatives /s/ and /f/ as shown in Appendix D). In place of production, velar consonants followed 85.0 percent of correct /ʃ/ responses. Velar consonants also preceded the highest percentage of correct /ʃ/ responses in the syllable releasing position. Labiodental consonants followed the lowest percentage of correct /ʃ/ responses at 76.3 percent. In the voicing feature of production, voiced consonants followed 83.8 percent of correct /ʃ/ responses and voiceless consonants followed 79.3 percent of correct /ʃ/ responses.

Differences in Phonetic Context for /tʃ/

The number and percentage of correct responses of /tʃ/ in all phonetic contexts are listed in Appendix D. In the syllable releasing position, 100 percent correct responses on /tʃ/ followed /k/, /f/, and /r/. These phones are not similar in manner or place of production but the /k/ and /f/ are both voiceless consonants. These consonants are also not similar to /tʃ/ in manner or place of production but the /k/, /f/, and /tʃ/ are all voiceless phonemes. In the syllable arresting position, 100 percent correct responses on /tʃ/ preceded /m/ and /r/. These phones are not similar to each other or to /tʃ/ in place and manner of production. The /m/ and /r/

are similar in the voicing feature of articulation, i.e., the /m/ and /r/ are both voiced consonants.

Table 9 and Figures 2, 3, and 4 (pages 40, 42, and 44, respectively) list the number and percentage of correct /tʃ/ responses according to manner, place and voicing of preceding consonants in the syllable releasing position. In manner of production, the range between subgroups was small, four percentage points, and the number and percentage of correct /tʃ/ responses was large. Nasal consonants preceded the highest percentage of correct /tʃ/ responses at 98.8 percent. Affricate consonants preceded the lowest percentage of correct /tʃ/ responses at 95.0 percent. In place of production, labiodental and velar consonants preceded 98.8 percent of correct /tʃ/ responses, the highest percentage of correct responses. The linguadental consonant /ʃ/ preceded 95.0 percent of correct /tʃ/ responses, the lowest percentage according to place of production. Voiced consonants preceded 97.5 percent of correct /tʃ/ responses and voiceless consonants preceded 97.1 percent of correct /tʃ/ responses.

The correct /tʃ/ responses in the syllable arresting position are presented in Table 9 and illustrated in Figures 2, 3, and 4. In manner of production, nasal and liquid consonants followed the highest percentage of correct /tʃ/ responses with 98.8 percent each. Fricative consonants followed the lowest percentage of correct /tʃ/

Table 9. Number of phonemes (N), correct and total responses (C/T), mean percent correct (%) and standard deviation (SD) of /tʃ/ responses for preceding consonants (PC) in syllable releasing position and for following consonants (FC) in syllable arresting position classified according to manner, place and voicing of production.

Syllable Releasing Position					Syllable Arresting Position				
PC	N	C/T	%	SD	FC	N	C/T	%	SD
				Manner of Production					
Stop Plosives	6	233/240	97.1	0.75	Stop Plosives	6	228/240	95.0	0.89
Nasals	2	79/80	98.8	0.71	Nasals	2	79/80	98.8	0.71
Fricatives	6	234/240	97.5	0.63	Fricatives	6	220/240	91.7	1.03
Affricates	1	38/40	95.0	--	Affricates	1	37/40	92.5	--
Liquids	2	78/80	97.5	1.41	Liquids	2	79/80	98.8	0.71
				Place of Production					
Bilabials	3	117/120	97.5	1.00	Bilabials	3	116/120	96.7	1.53
Labiodental	2	79/80	98.8	0.71	Labiodental	2	74/80	92.5	1.41
Linguadental	1	38/40	95.0	--	Linguadental	1	38/40	95.0	--
Alveolar	7	272/280	97.1	0.69	Alveolar	7	266/280	95.0	1.63
Palatal	2	77/80	96.3	0.71	Palatal	2	73/80	91.3	0.71
Velar	2	79/80	98.8	0.71	Velar	2	76/80	95.0	0.00
				Voicing of Production					
Voiced	10	390/400	97.5	0.67	Voiced	10	381/400	95.3	1.37
Voiceless	7	272/280	97.1	0.90	Voiceless	7	262/280	93.6	1.40

responses at 91.7 percent. In place of production, bilabial consonants followed the highest percentage of correct /tʃ/ responses at 96.7 percent. Palatal consonants followed the lowest percentage of correct responses at 91.3 percent. A narrow range of percentages was calculated for the voicing feature of production. Voiced consonants followed 95.3 percent of correct /tʃ/ responses and voiceless consonants followed 93.6 percent of correct /tʃ/ responses in the syllable arresting position.

Differences in Phonetic Context for /dʒ/

The variations in the number and percentage of correct productions of /dʒ/ according to changes in phonetic context are listed in Appendix D. Correct responses of /dʒ/ in the syllable arresting position were greater than those in the syllable releasing position. Of the five phonemes selected to be analyzed in this study, /dʒ/ is the only phoneme that had consistently more correct responses in the syllable arresting position across all 17 phonetic environments studied. In the syllable releasing position, the most correct responses of /dʒ/ followed the /t/ consonant. The /t/ and /dʒ/ are not similar in manner, place or voicing features of production. The least correct responses of /dʒ/ followed the /v/ consonant. The /v/ and /dʒ/ are not similar in

manner or place of production but are similar in voicing of production. In the syllable arresting position, the most correct /dʒ/ responses preceded the /l/ consonant. The /l/ and /dʒ/ consonants are not similar in manner or place of production but are similar in voicing of production. The least correct /dʒ/ responses preceded the /z/ consonant. The /z/ and /dʒ/ are not similar in manner or place of production but are similar in voicing of production.

For the syllable releasing position, manner, place and voicing features were analyzed for the consonants which preceded correct responses. This analysis is presented in Table 10. In manner of production, stop plosives preceded the highest percentage of correct /dʒ/ responses at 77.9 percent. Fricative consonants preceded the lowest percentage of correct /dʒ/ responses at 68.8 percent. Alveolar consonants preceded the highest percentage of /dʒ/ responses in place of production at 90.0 percent. Palatal consonants preceded the lowest percentage of correct /dʒ/ responses at 68.0 percent. In voicing of production, voiced and voiceless consonants both preceded 73.0 percent of correct /dʒ/ responses.

In the syllable arresting position, liquid consonants followed the highest percentage of correct /dʒ/ responses at 95.0 percent. Affricate consonants followed the lowest percentage of correct /dʒ/ responses at 82.5

Table 10. Number of phonemes (N), correct and total responses (C/T), mean percent correct (%), and standard deviation (SD) of /dʒ/ responses for preceding consonants (PC) in syllable releasing position and for following consonants (FC) in syllable arresting position classified according to manner, place and voicing of production.

Syllable Releasing Position					Syllable Arresting Position				
PC	N	C/T	%	SD	FC	N	C/T	%	SD
Manner of Production									
Stop Plosives	6	187/240	77.9	1.47	Stop Plosives	6	211/240	87.9	1.17
Nasals	2	59/80	73.8	2.12	Nasals	2	72/80	90.0	0.00
Fricatives	6	165/240	68.8	1.22	Fricatives	6	215/280	89.6	1.94
Affricates	1	28/40	70.0	--	Affricates	1	33/40	82.5	--
Liquids	2	58/80	72.5	1.41	Liquids	2	76/80	95.0	1.41
Place of Production									
Bilabials	3	92/120	76.7	1.53	Bilabials	3	104/120	86.7	1.53
Labiodental	2	55/80	68.8	2.12	Labiodental	2	73/80	91.3	0.71
Linguadental	1	28/40	70.0	--	Linguadental	1	36/40	90.0	--
Alveolar	7	252/280	90.0	2.16	Alveolar	7	252/280	90.0	2.16
Palatal	2	54/80	67.5	1.41	Palatal	2	70/80	87.5	2.83
Velar	2	63/80	78.8	0.71	Velar	2	72/80	90.0	0.00
Voicing of Production									
Voiced	9	262/360	72.8	1.83	Voiced	9	322/360	89.4	1.86
Voiceless	8	235/320	73.4	2.39	Voiceless	8	285/320	89.1	1.69

percent. In place of production, labiodental consonants followed the highest percentage of correct /dʒ/ responses (91.3 percent). Bilabial consonants followed the lowest percentage of correct /dʒ/ responses (86.7 percent). As in the syllable releasing position, voiced and voiceless consonants followed the same percentage of correct /dʒ/ responses, 89.0 percent.

Review of Differences in Phonetic Context for Five Selected Phonemes in the Syllable Releasing Position

The mean percentage of correct responses of all five selected phonemes according to the preceding consonants' manner, place and voicing features in the syllable releasing position is illustrated in Figure 5. Under manner of production of the preceding consonant, the fricatives /s/, /ʃ/, and /z/ and affricate /tʃ/ have similar trends in the mean percentage of correct responses. In manner of production, liquid consonants which preceded /s/, /z/, /ʃ/, and /tʃ/ were consistently associated with the highest percentage of correct responses (for /tʃ/, nasal consonants also preceded a high percentage of correct responses). Affricate consonants preceded the lowest percentage of correct responses for /s/, /z/, /ʃ/, and /tʃ/. Although trends were similar for fricative /s/, /z/, and /ʃ/ and the affricate /tʃ/, the fricative /z/ had consistently lower numbers and percentages of correct responses.

Figure 5. Percentages of correct responses of five phonemes according to preceding consonants' manner, place and voicing of production in the syllable releasing position.

Key: A. = Alveolars, Aff. = Affricates, B. = Bilabials, F. = Fricatives, Lab. = Labiodentals, Lin. = Linguadental, Liq. = Liquids, N. = Nasals, P. = Palatals, S.P. = Stop Plosives, V. = Velars, V.' = Voiced, V.'' = Voiceless.

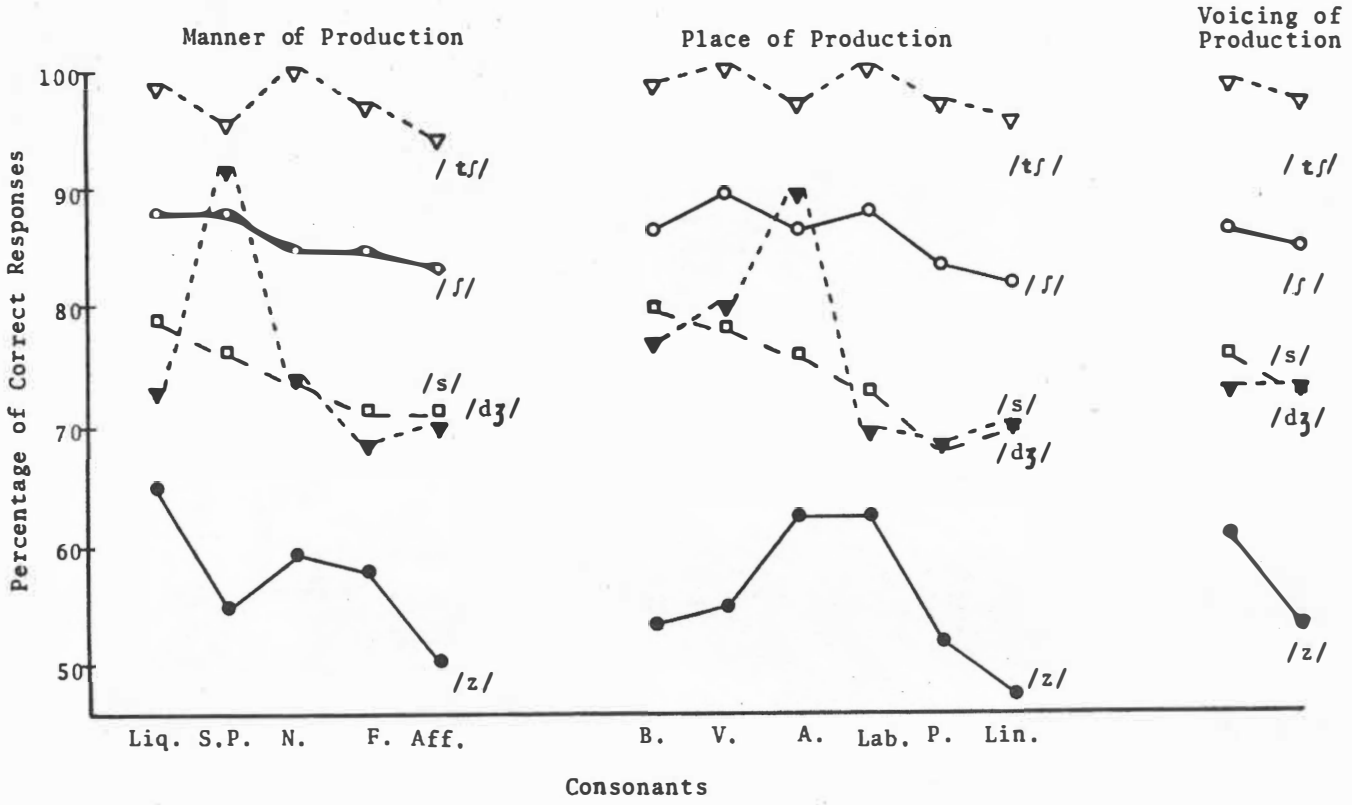
Manner of Production
Place of Production
Voicing of Production
Percentage of Correct Responses
100
90
80
70
60
50
/tʃ/
/ʃ/
/s/
/dʒ/
/z/
Liq.
S.P.
N.
F. Aff.
B.
V.
A.
Lab.
P.
Lin.
Consonants

Figure 5

The affricate /dʒ/ did not follow the same trends as the other four selected phonemes. Stop plosives, instead of liquids, preceded the highest percentage of correct /dʒ/ responses. Fricative consonants, instead of affricate consonants, preceded the lowest percentage of correct /dʒ/ responses. In general, liquids and stop plosives preceded the highest percentage of correct responses across all five phonemes. Fricatives and affricates were associated with the lowest percentage of correct responses across all five phonemes. The highest percentage of correct responses occurred on the /tʃ/ and the lowest percentage of correct responses occurred on the /z/.

Percentages of correct responses across phonemes are presented for place of production of preceding consonants in Figure 5. Again percentages of correct responses for /s/, /z/, /ʃ/, and /tʃ/ are consistent and percentages of correct /dʒ/ responses are not consistent with the four other phonemes. Velar, labiodental and bilabial consonants preceded the highest percentage of correct responses for the palatal phonemes /tʃ/ and /ʃ/ and the alveolar phoneme /s/. Alveolar consonants preceded the highest percentage of correct responses for the alveolar phoneme /z/ and palatal phonemes /dʒ/. Labiodental consonants also preceded the highest percentage of correct /z/ responses. The linguadental /θ/ preceded

the lowest percentage of correct responses for /s/, /z/, /ʃ/, and /tʃ/. Palatal consonants preceded the lowest percentage of correct responses for the palatal phoneme /dʒ/.

Percentages of correct responses across phonemes are also presented for voicing of production of preceding consonants in Figure 5. Voicing trends were consistent among four of the five selected phonemes. Voiced preceding consonants were associated with the highest percentage of correct responses for /s/, /z/, /ʃ/, and /tʃ/ while voiceless preceding consonants were associated with lower percentages of correct responses. In all four cases, however, the difference in percentages between voiced and voiceless preceding consonants was less than 7.0 percent. The /dʒ/ phoneme did not follow the same trend. Both voiced and voiceless consonants preceded the same percentage of correct /dʒ/ responses.

Review of Differences in Phonetic Context for Five Selected Phonemes in the Syllable Arresting Position

Figure 6 illustrates the comparisons of the mean percentage of correct responses of all five phonemes according to the following consonants' manner, place and voicing features of production. The affricate /tʃ/ had the highest percentage of correct responses in the syllable arresting position (this is in agreement with the syllable releasing position). The fricative /z/ also had the

Figure 6. Percentages of correct responses of five phonemes according to following consonants' manner, place and voicing of production in the syllable arresting position.

Key: A. = Alveolars, Aff. = Affricates, B. = Bilabials, F. = Fricatives, Lab. = Labiodentals, Lin. = Linguadental, Liq. = Liquids, N. = Nasals, P. = Palatals, S.P. = Stop Plosives, V. = Velars, V.' = Voiced, V.'' = Voiceless.

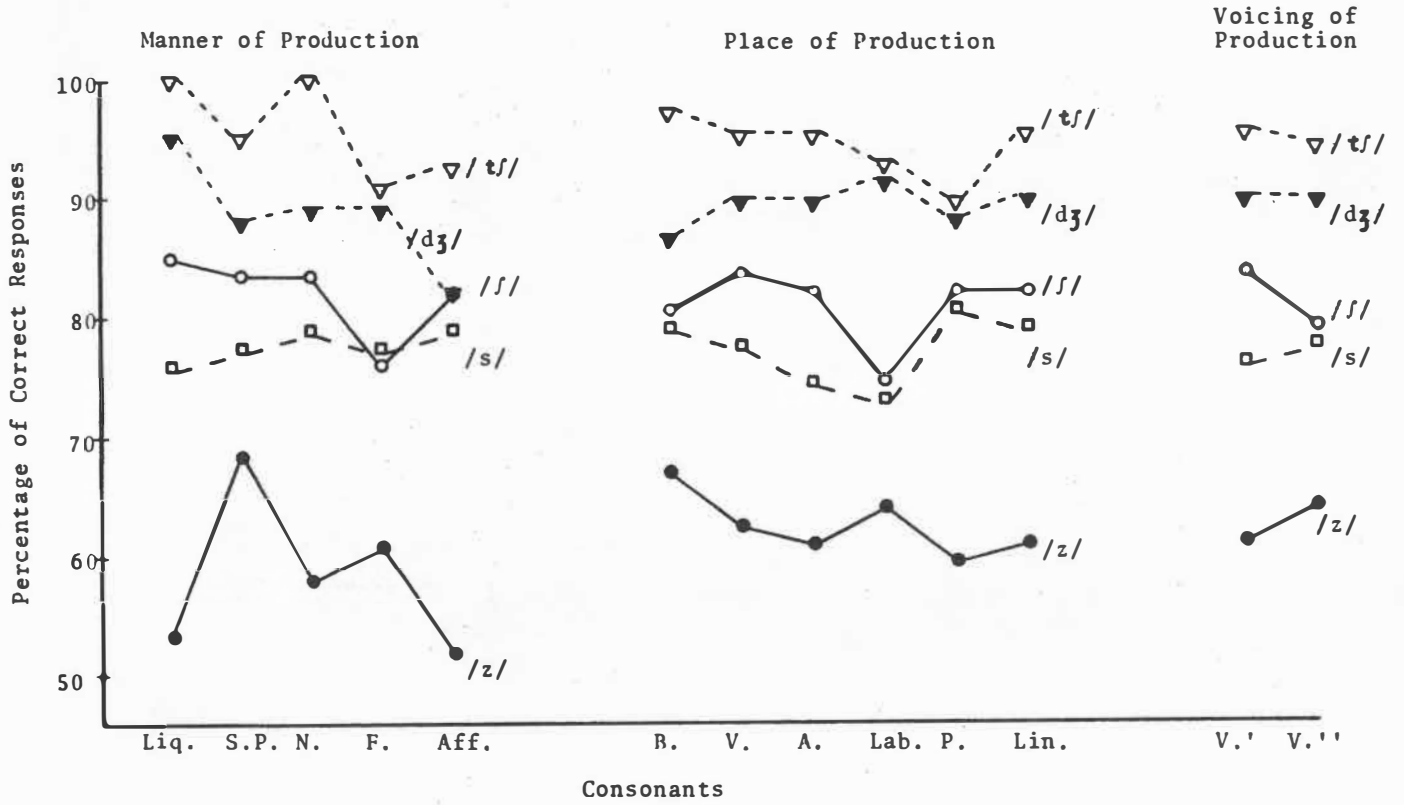
Manner of Production
Place of Production
Voicing of Production
Percentage of Correct Responses
100
90
80
70
60
50
/tʃ/
/dʒ/
/ʃ/
/s/
/z/
Liq.
S.P.
N.
F.
Aff.
B.
V.
A.
Lab.
P.
Lin.
V.'
V.''
Consonants

Figure 6

lowest percentage of correct responses in the syllable arresting position, also in agreement with the syllable releasing position. In manner of production, liquids and nasal consonants followed the highest percentage of correct responses for the affricates /tʃ/ and /dʒ/ and the fricative /ʃ/. Liquid consonants also preceded the highest percentage of correct responses in the releasing syllable position. Fricative and affricate consonants followed the lowest percentages of correct responses for all five phonemes.

In place of production, bilabial and velar consonants followed the highest percentage of correct responses across all phonemes with one exception. Velar consonants did not follow a high percentage of correct responses for the alveolar phoneme /z/. These results agree with those obtained in the syllable releasing position for /s/, /ʃ/, and /tʃ/. Labiodental and palatal consonants followed the lowest percentage of correct responses. This is not in agreement with the results reported in the syllable releasing position with the exception of the phoneme /dʒ/. Palatal consonants preceded the lowest percentage of correct responses for /dʒ/ in the syllable releasing position and followed the lowest percentage of correct responses for /dʒ/, /tʃ/, and /z/ in the syllable arresting position.

Voicing trends are also illustrated in Figure 6. The voiceless phonemes /tʃ/ and /ʃ/ and higher percentages of correct responses when followed by voiced consonants. The fricatives /s/ and /z/ had higher percentages of correct responses when followed by voiceless consonants. The range of differences was small, only 5.0 percent. As in the syllable releasing position, the /dʒ/ had the same percentage of correct responses when the following consonant was voiced or voiceless.

IV. SUMMARY OF RESULTS

With the exceptions noted, the results of this study are summarized below:

1. The mean number of correct responses in the syllable releasing and arresting positions varied differently for the five phonemes produced by six-year-old articulatory defective children. This is, the mean number of correct responses in the syllable arresting position were slightly higher for /s/ and /z/ and much higher for /dʒ/. The mean number of correct responses in the syllable releasing position were higher for /ʃ/ and /tʃ/.

2. When each phoneme was analyzed separately, the phoneme /tʃ/ had significantly more correct responses in the syllable releasing position. The phoneme /dʒ/ had significantly more correct responses in the syllable arresting position.

3. There were no significant differences in correct /s/, /z/, and /ʃ/ productions between syllable releasing and arresting positions for six-year-old children with defective articulation.

4. There is substantial individual variability on the /s/, /z/, and /dʒ/ responses of the articulatory defective children. Individual variation on the production of /ʃ/ and /tʃ/ responses of articulatory defective children is small.

5. In manner of production, liquid and stop plosive consonants preceded the highest percentages of correct /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ responses in the syllable releasing position.

6. In manner of production, fricative and affricate consonants preceded the lowest percentages of correct /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ responses in the syllable releasing position.

7. In place of production, velar, labiodental and bilabial consonants preceded the highest percentages of /s/, /ʃ/, and /tʃ/ responses in the syllable releasing position. Alveolar consonants preceded the highest percentages of correct /z/ and /dʒ/ responses in the syllable releasing position.

8. In place of production, the linguadental /θ/ preceded the lowest percentages of correct /s/, /z/, /ʃ/, and /tʃ/ responses. Palatal consonants preceded the

lowest percentage of correct /dʒ/ responses in the syllable releasing position.

9. In voicing of production, voiced consonants preceded higher percentages of correct responses than voiceless consonants in the syllable releasing position.

10. In manner of production, liquid and nasal consonants followed the highest percentages of correct /tʃ/, /ʃ/, and /dʒ/ responses in the syllable arresting position. Affricates followed the highest percentage of correct /s/ responses and stop plosives followed the highest percentage of correct /z/ responses in the syllable arresting position.

11. In manner of production, fricative and affricate consonants followed the lowest percentages of correct /z/, /tʃ/, and /dʒ/ responses in the syllable arresting position.

12. In place of production, bilabial and velar consonants followed the highest percentages of correct /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ responses in the syllable arresting position.

13. In place of production, labiodental and palatal consonants followed the lowest percentages of correct /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ responses in the syllable arresting position.

14. In voicing of production, voiced consonants followed the highest percentage of correct /ʃ/ and /tʃ/

responses. Voiceless consonants followed the highest percentage of correct /s/ and /z/ responses in the syllable arresting position.

CHAPTER IV

DISCUSSION

I. DIFFERENCES IN CORRECT RESPONSES BETWEEN SYLLABLE RELEASING AND ARRESTING POSITIONS AMONG FIVE PHONEMES FOR CHILDREN WITH DEFECTIVE ARTICULATION

The major finding of this investigation was that the mean number of correct responses, in the two syllable positions, varied differently for each of the five phonemes. That is, the mean number of correct responses in the syllable releasing position were higher for /ʃ/ and /tʃ/. The mean number of correct responses in the syllable arresting position were higher for /s/, /z/, and /dʒ/.

This finding does not agree with results reported by Scott and Milisen (1954). They 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 the initial consonants in words is to release the first syllable of that word and the function of the final consonants in words is to arrest the final syllable of that word, one would expect more correct consonant productions in the syllable releasing position, at least

during isolated word production. Slightly more correct responses occurred in the syllable arresting position in the present study.

One explanation for the differences in results of the present study and those reported by Scott and Milisen (1954) may be related to the particular speech tasks involved. Scott and Milisen's subjects produced single word responses. Subjects in the present study produced disyllabic or trisyllabic utterances composed of two abutted words. If indeed, the syllable is the basic programmed unit of speech (Ohman, 1966; Kozhevnikov and Chistovich, 1965), it may be that children with defective articulation are somewhat less accurate at programming sequential syllables. Thus the programming of the first syllable may interfere with the accurate programming of the following syllable. While this may be a possible explanation for differences between the present study and other studies, no research is yet available to support such a contention.

Another explanation for the major result of this study is that differences in subject variation occurred. For the /tʃ/ very little subject variation was noted and the means between syllable releasing and arresting positions were significantly different. For the /s/ and /z/ however, more subject variation was reported, i.e., larger standard deviations were reported and the means in the

syllable releasing and arresting positions were not significantly different in correct number of responses.

The second major finding of this study was that for the phoneme /tʃ/, significantly more correct responses occurred in the syllable releasing position. For the phoneme /dʒ/ significantly more correct responses occurred in the syllable arresting position.

These results on the phoneme /tʃ/ agree with results reported by Scott and Milisen (1954). The results on the phoneme /dʒ/ agree with results reported by Pennington (1977) and Appleton (1969) although different phonemes were studied. This finding may also be compared with results of studies which report differences in the consistency of correct consonant production as a function of age. McDonald (1964) and Appleton (1969) reported that normal children had a significant increase in the consistency of correct consonant productions as they got older. By seven years, normal speaking children tend to correctly produce /s/ in most phonetic contexts in both syllable releasing and syllable arresting positions (Appleton, 1969). Appleton also reported that the consistency of correct production increased uniformly, as a function of age, from five to seven years for both syllable positions. Since the difference between syllable positions was significant for two phonemes (/tʃ/ and /dʒ/) produced by articulatory defective children and the

syllable positions were not consistent, it is unlikely that consistency of correct productions increased uniformly in both syllable positions as a function of age. This investigator found no other research to date which determined articulatory defective children's consistency of correct articulation for both syllable positions. It is possible that articulatory defective children utilize a different phonological system than normal children.

The finding that there are no significant differences in correct /s/, /z/, and /ʃ/ productions between syllable releasing and arresting positions for six-year-old children with defective articulation is in agreement with Appleton's (1969) reported data. She reported no significant difference between the syllable positions for normal articulating six-year-old children on /s/ and /r/ phonemes. This finding is not in agreement with Pennington's (1977) data. Pennington reported statistically significant differences between syllable releasing and arresting position in the number of correct /s/ responses by articulatory defective children. Although no significant difference was reported between the syllable positions for the /s/ phoneme, the trend in the present study agrees with that reported by Pennington. That is, more correct /s/ responses were produced in the syllable arresting position than in the syllable releasing position by articulatory defective subjects.

Among the differences between the Pennington study and the present study are the following. First, Pennington's subjects were five-year-old articulatory defective children. Perhaps changes in syllabic programming occur with changes in chronological age. If such changes do occur with age, perhaps the syllabic position of a target phoneme influences the correctness of its production differently in different age groups. Second, all of Pennington's subjects scored 24 or below on the Templin-Darley Screening Test of Articulation. One explanation for the higher Templin-Darley scores could be the age difference between the two groups. Although the severity of the articulation disordered subjects may have been similar in the two studies, the subjects in the present study scored higher on the Templin-Darley Screening Test of Articulation.

The results of this study are consistent with the reported findings of Zehel et al. (1972). They reported that articulatory defective subjects made more correct /s/ responses in the syllable arresting position than in the syllable releasing position. The results of this study partially support the Ingram (1974) hypothesis. He speculated that back consonants (velars) will be more easily acquired in the syllable arresting positions for normal articulatory children. The articulatory defective children in the present study did have significantly more

correct productions of the palatal (back) consonant /dʒ/ in the syllable arresting position. However, the subjects in this study had significantly more correct productions in the syllable releasing position on the palatal consonants /ʃ/ and /tʃ/.

II. DIFFERENCES IN PHONETIC CONTEXT FOR SYLLABLE RELEASING AND ARRESTING POSITIONS

Differences in Phonetic Context for /s/

The results of the present study do not support the finding by Zehel et al. (1972). They reported that among articulatory defective children differences in the number of correct /s/ responses existed between syllable releasing and arresting positions and these differences varied as a function of the particular phonetic context in which the /s/ occurred. Specifically, in the syllable releasing position, Zehel et al. reported that scores were significantly higher for /rs/ than for /dʒs/ or /ts/. In the syllable arresting position, Zehel et al. reported that in the /sʃ/ and /sz/ contexts correct /s/ productions were produced significantly less frequently than in /sn/, /sk/, /st/, or /sd/ contexts. The results of the present study do not support those results given by Zehel et al. The results in the present data suggest that the consonant /ʃ/ preceded a substantially lower number of correct /s/ responses by articulatory defective six-year-old

children while the consonant /ʃ/ followed the highest number and percentage of correct /s/ responses. The /ʃ/ and /s/ are similar in manner of articulation. This result is in agreement with Winitz's (1975) hypothesis on right-to-left coarticulatory effects.

Gallagher and Shriner (1975b) reported no relationship between preceding sounds and the accuracy of /s/ and /z/ production. In the syllable arresting position, place and manner of articulation of consonants were significantly related to the accuracy of /s/ and /z/ productions. Gallagher and Shriner reported that consonants similar in place of production had the most effect on accurate /s/ and /z/ productions. In the present study, alveolar consonants followed 75.0 percent correct /s/ productions and 62.1 percent correct /z/ production. These percentages were not the highest or lowest ones for both phonemes. In general, following consonants similar to /s/ and /z/ in manner of production, were associated with higher percentages of correct /s/ and /z/ responses in this investigation.

Across all 17 consonants, the percentages of correct responses for /s/ in the syllable releasing and arresting positions were similar. In place of production, palatal consonants which follow /s/ in the syllable arresting position followed 13.0 percent more correct /s/ responses than in the syllable releasing position.

The palatal consonants used in this study were /ʃ/, /tʃ/, and /dʒ/. The palatal consonants may have facilitated more correct /s/ responses due to similarity in place with the alveolar /s/ phoneme and due to right-to-left coarticulatory effects in which anticipatory speech movements similar to the target phoneme facilitate the target phoneme production.

Differences in the Phonetic Context for /z/

Gallagher and Shriner (1975b), using normal subjects, reported there were no significant effects from preceding consonants on /z/ when it was in the syllable releasing position. According to the results of the present study, in manner of production, liquid consonants preceded the highest percentage of correct /z/ responses (70.0 percent). These results might be explained by a similarity in place between these preceding consonants and the target phoneme /z/.

In the syllable arresting position, Gallagher and Shriner (1975b) reported that stop plosive consonants followed the most accurate /z/ productions. The results of the present study agree with Gallagher and Shriner's results. Stop plosive consonants followed the highest percentage of correct /z/ responses in the syllable arresting position. At the present time no explanation can be given on why stop plosives facilitate correct /z/

responses in the syllable arresting position. In the current study, palatal and linguadental following consonants appear to be more facilitatory to /z/ in the syllable arresting position than in the syllable releasing position. This may be related to the fact that two of the four adjacent phones in these groups are common in manner to the fricative /z/. No research to date, however, is available to support the contention that similarities in manner of production may be facilitatory to a target phoneme.

Differences in Phonetic Context on /ʃ/, /tʃ/, and /dʒ/

A search of the literature has not revealed other investigators who have studied relationships between syllable positions and phonetic environment in children with defective articulation for the phonemes /ʃ/, /tʃ/, and /dʒ/. For the /ʃ/ more correct responses occurred in the releasing syllable position for all phonetic environments, although the differences between correct responses in syllable releasing and arresting positions were small. In manner of production, labiodental consonants preceded 12.0 percent more correct /ʃ/ responses in the syllable releasing position than in the syllable arresting position. Labiodental consonants are similar in manner of production to /ʃ/. This result supports findings by Gallagher and Shriner (1975b).

The highest percentages of correct responses were reported on /ʧ/ in both syllable arresting and releasing positions than any other phoneme in this study. No phonetic context appears to facilitate substantially more correct responses in either syllable position since all contexts are associated with a percentage of 90.0 percent or more in correct responses.

For the phoneme /dʒ/, all phonetic environments in the syllable arresting position followed higher percentages of correct /dʒ/ responses. Liquid and fricative consonant environments followed 20.0 percent more correct /dʒ/ responses than the same consonant environments in the syllable releasing position. Liquid and fricative consonants are not similar to /dʒ/ in place or manner of production. In place of production, three groups of consonants are associated with significantly more correct /dʒ/ responses. Labiodental, palatal and linguadental consonants followed the correct /dʒ/ responses in the arresting position which differed most from the syllable releasing position. Labiodental and linguadental environments are not similar in place to the /dʒ/ phoneme. However, palatal consonants are similar to /dʒ/ in place of production. This result supports results reported by Gallagher and Shriner (1975b). They reported that consonants similar in place followed more correct /s/ and /z/ productions. Unlike the other four phonemes, a

large difference between syllable releasing and arresting positions in the voicing feature occurred. Voiced and voiceless consonants followed more correct /dʒ/ responses in the arresting syllable position. To date there is no research to explain this result.

Review of Differences in Phonetic Context for Syllable Arresting and Releasing Positions

Some differences in results between the present study and other studies have been discussed. These differences include the number of correct phoneme responses in syllable releasing and arresting positions and the influences of phonetic context on correct phoneme responses for syllable releasing and arresting positions.

Several possible explanations for the differences in results in this study and other studies can be offered. One difference between the present study and other studies is the elicitation procedure. Gallagher and Shriner (1975b) studied responses of normal children during spontaneous speech while the present study investigated responses of articulatory defective children to formal articulation testing. Another difference is related to the type of subject. Some studies reviewed had normal subjects (Gallagher and Shriner, 1975a; 1975b). In the Zehel et al. (1972), Pennington (1977) and present study, articulatory defective subjects were used. Also individual subject variation may be a partial explanation

of the reported differences in results among studies. Some of the articulatory defective subjects in the present study had consistent omission or substitution errors in one or both syllable positions. The error patterns appeared to be so well established that neither syllable position nor phonetic context had an effect on correct production of /s/, /z/, /ʃ/, /tʃ/, or /dʒ/. In the present study, no attempt was made to determine the degree to which these subjects were stimulable when given cues by the investigator. It may be that the degree to which a phoneme is stimulable, for a child, in either syllable position, affects the degree to which phonetic context influences correct productions. Also, in the present study, there was no attempt to control for which sounds were defective. When studying the effects of phonetic context on correct productions of any phoneme, the ability of the subjects to correctly produce the phones adjacent to the target phoneme may need to be considered.

III. CLINICAL IMPLICATIONS

According to the findings of this study, several clinical implications can be suggested. They include:

1. The routine diagnostic tests employed in analyzing defective articulation should include measures of the individual's ability to correctly produce phonemes

in both syllable releasing and arresting positions since the reported results were different for different phonemes and syllable position.

2. According to the results of the present study, the number of correct responses of a given target phoneme may vary according to syllable position. For example, in the results of the present study, significantly more correct productions of /dʒ/ did occur in the syllable arresting position for six-year-old articulatory defective children. In the therapy setting, the clinician should be aware of syllable positions for certain target phonemes when planning and executing therapy goals.

3. Different phonetic contexts appear to facilitate correct phoneme production of /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ in the syllable releasing and arresting positions. For example, the fricative /ʃ/ followed the highest number and percentage of correct /s/ responses in the syllable arresting position. However the /ʃ/ preceded a substantially lower number of correct /s/ responses in the syllable releasing position by six-year-old articulatory defective children. The percentage difference was 25.0 percent. Therapy tasks and stimuli should include phonetic contexts which facilitate correct phoneme production in both syllable positions.

4. Since the results of the present study are in agreement with Winitz' (1975) hypothesis on right-to-left

coarticulatory effects, consonants similar to the target phoneme in place and manner of production should follow the target phoneme in selected speech stimuli.

IV. SUGGESTIONS FOR FUTURE RESEARCH

From the results of this study, further research is needed to provide more data on the effects of syllable releasing and arresting positions and the effects of phonetic contexts 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 phoneme production varied among the different phonemes, further research is needed to determine if different trends occur for other frequently misarticulated consonants, in other age groups, and in spontaneous speech samples.

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

3. Since the results of the present study do not support recent research, a study similar to the present one with subjects varying in degrees of articulatory severity is needed to determine in which syllable position the most correct responses are produced for a given phoneme.

4. Since differences in correct responses between syllable positions were specific to particular phonetic contexts for some phonemes, further study is needed to evaluate the effects of phonetic contexts in other frequently misarticulated phonemes.

5. Since the results of the present study support the Winitz hypothesis on right-to-left facilitating coarticulatory effects, a research study designed to assess right-to-left coarticulatory effects in syllable releasing and arresting positions is needed.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purposes of this study were: (1) to investigate the effects of syllable releasing and arresting positions on correct /s/, /z/, /ʃ/, /tʃ/, and /dʒ/ productions by articulatory defective children; and (2) to investigate the effects of varying phonetic contexts on correct productions of the five phonemes in syllable releasing and arresting positions by articulatory defective children.

Forty children 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 defective articulation. The speech stimuli used in this study were 34 different phonemes selected from the McDonald Picture Deep Test of Articulation: 17 items in which the phoneme (/s/, /z/, /ʃ/, /tʃ/, or /dʒ/) occurred in a syllable releasing position and 17 items in which the phoneme occurred in the syllable arresting position. After the child had practiced naming pairs of demonstration pictures, the phonemes were deep tested. All responses were judged as correct or incorrect by the investigator at the time of testing.

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

1. Children with articulatory defects produced significantly more correct /tʃ/ responses in the syllable releasing position and they produced significantly more correct /dʒ/ responses in the syllable arresting position.

2. Although children with articulatory defects produced on the average more correct /ʃ/ responses in the syllable releasing position than in the syllable arresting position, the difference was not significant.

3. Although children with articulatory defects produced on the average more correct /s/ and /z/ responses in the syllable arresting position than in the syllable releasing position, the difference was not significant.

4. Variability in correct phoneme production in articulatory defective children differs for each of the phonemes. That is, more variability in /s/, /z/, and /dʒ/ occurred in this study and less variability occurred in /ʃ/ and /tʃ/.

5. Different phonetic contexts appear to facilitate correct phoneme production in the syllable releasing position and in the syllable arresting position.

6. Further research is needed to provide more data on the effects of syllable positions and phonetic contexts on the responses of articulatory defective children.

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APPENDICES

APPENDIX A

SPEECH STIMULI USED IN TESTING PROCEDURE

Table 11. Example of speech stimuli for selected phoneme /s/.

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
/zs/	KEYSsun	/sz/	houseZEBRA
/ʃs/	FISHsun	/sʃ/	houseSHEEP
/tʃs/	WATCHsun	/stʃ/	houseCHAIR
/dʒs/	CAGEsun	/sdʒ/	houseGIRAFFE
/ls/	BALLsun	/sl/	houseLAMP
/rs/	CARsun	/sr/	houseRAKE

APPENDIX B

SEX, AGE AND SCREENING RESULTS OF SUBJECTS

Table 12. Sex, chronological age (C.A.), Peabody Picture Vocabulary Test (PPVT) I.Q., and Templin-Darley Screening Test of Articulation Score for each articulatory defective subject.

Subject	C.A. (Yrs.-Mos.)	PPVT I.Q.	Templin-Darley	Sex
1	6-0	115	27	Male
2	6-10	93	34	Male
3	6-0	107	29	Male
4	6-2	142	25	Male
5	6-11	95	26	Male
6	6-9	131	33	Male
7	6-3	97	32	Male
8	6-6	98	28	Female
9	6-5	93	32	Female
10	6-4	95	23	Male
11	6-10	89	34	Male
12	6-1	89	31	Male
13	6-8	85	33	Male
14	6-0	107	34	Male
15	6-0	110	31	Female
16	6-5	117	34	Male
17	6-7	102	31	Male
18	6-4	109	34	Female
19	6-6	110	29	Male
20	6-10	93	29	Female
21	6-4	99	33	Female
22	6-7	91	16	Male
23	6-4	95	32	Male
24	6-2	113	34	Female
25	6-0	106	33	Female
26	6-10	99	33	Male
27	6-0	113	28	Male
28	6-0	107	28	Male
29	6-2	109	28	Female
30	6-9	110	24	Male
31	6-5	85	31	Female
32	6-1	115	32	Female
33	6-2	109	34	Male
34	6-8	102	33	Female
35	6-0	95	33	Male
36	6-1	97	30	Male
37	6-1	91	29	Male
38	6-10	91	34	Male
39	6-10	120	29	Male
40	6-6	97	34	Male
	Mean C.A.	Mean I.Q.	Mean Artic. Score	Sex
	6-5	103	30.4	28 Male 12 Female

APPENDIX C

PERCENT AGREEMENT SCORES FOR INTRA- AND INTERJUDGE RELIABILITY

Intrajudge agreement: Judge 1

$$\frac{475 \text{ agreements}}{35 \text{ disagreements}} = 93 \text{ percent agreement}$$

Intrajudge agreement: Judge 2

$$\frac{468 \text{ agreements}}{42 \text{ disagreements}} = 92 \text{ percent agreement}$$

Interjudge agreement: Judge 1 and Judge 2

$$\frac{470 \text{ agreements}}{40 \text{ disagreements}} = 92 \text{ percent agreement}$$

Intrasubject agreement: Ten subjects

$$\frac{93 \text{ agreements}}{7 \text{ disagreements}} = 93 \text{ percent agreement}$$

APPENDIX D

RAW DATA ON NUMBER AND PERCENTAGE OF CORRECT RESPONSES

Table 13. Number and percent correct of /s/ productions by preceding consonant (PC) in syllable releasing position and by following consonant (FC) in syllable arresting position.

Releasing Position			Arresting Position		
PC	Number	Percent Correct	FC	Number	Percent Correct
p	35	87.5	p	34	85.0
b	31	77.5	b	31	77.5
t	28	70.0	t	29	72.5
d	29	72.5	d	27	67.5
k	31	77.5	k	32	80.0
g	31	77.5	g	31	77.5
m	30	75.0	m	31	77.5
n	29	72.5	n	32	80.0
f	30	75.0	f	28	70.0
v	29	72.5	v	31	77.5
θ	28	70.0	θ	32	80.0
z	32	80.0	z	31	77.5
ʃ	24	60.0	ʃ	34	85.0
tʃ	28	70.0	tʃ	30	75.0
dʒ	29	72.5	dʒ	33	82.5
l	35	87.5	l	32	80.0
r	28	70.0	r	29	72.5

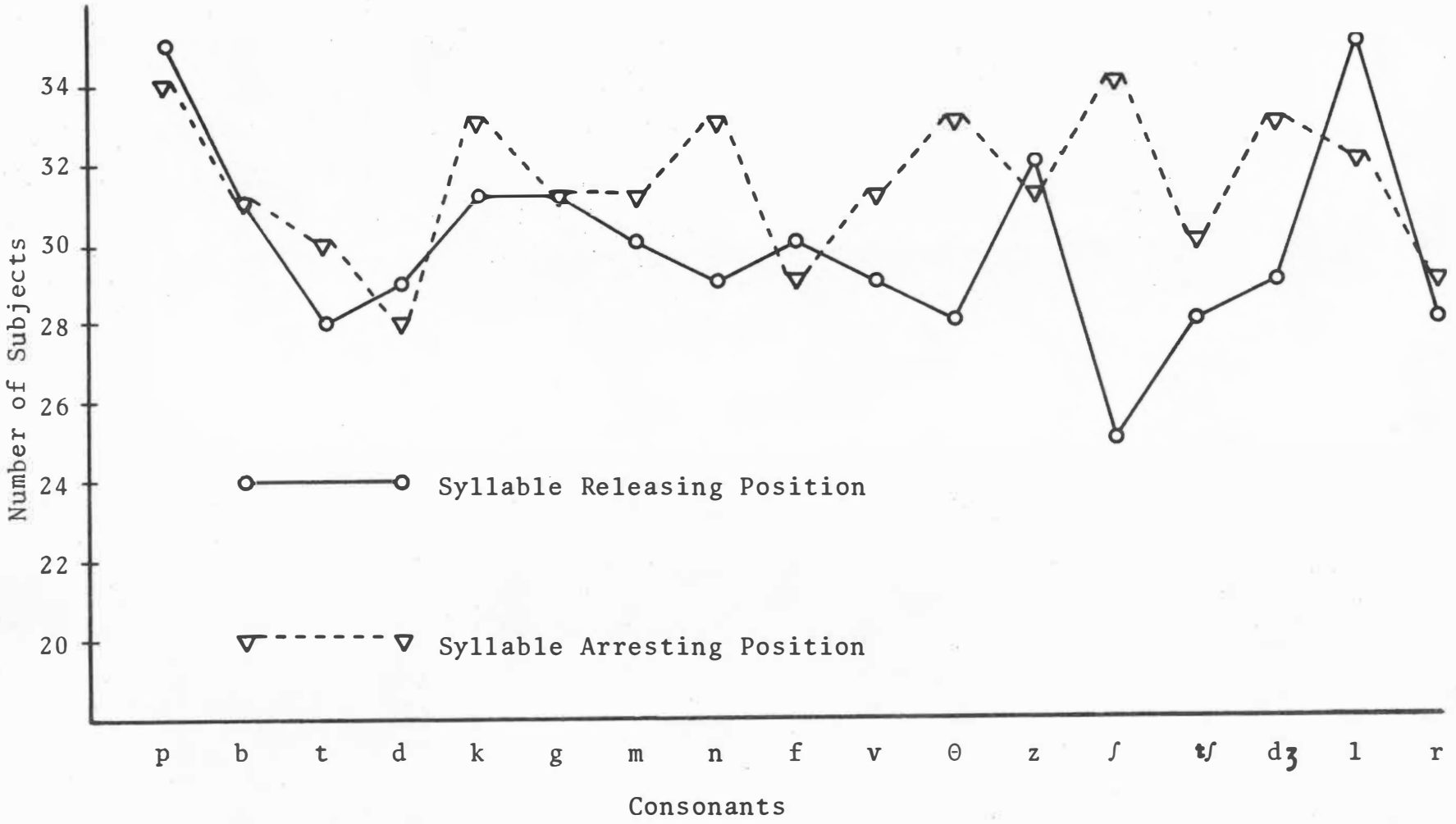

Figure 7. Number of subjects correctly producing the /s/ in syllable releasing and arresting positions for each phonetic context.

Table 14. Number and percent correct of /z/ productions by preceding consonant (PC) in syllable releasing position and by following consonant (FC) in syllable arresting position.

Releasing Position			Arresting Position		
PC	Number	Percent Correct	FC	Number	Percent Correct
p	20	50.0	p	31	77.5
b	23	57.5	b	27	67.5
t	24	60.0	t	27	67.5
d	22	55.0	d	27	67.5
k	22	55.0	k	27	67.5
g	23	57.5	g	23	57.5
m	23	57.5	m	24	60.0
n	24	60.0	n	23	57.5
f	24	60.0	f	25	62.5
v	26	65.0	v	27	67.5
θ	18	45.0	θ	25	62.5
s	25	62.5	s	27	67.5
ʃ	21	52.5	ʃ	25	62.5
tʃ	18	45.0	tʃ	20	50.0
dʒ	21	52.5	dʒ	24	60.0
l	26	65.0	l	22	55.0
r	30	75.0	r	23	57.5

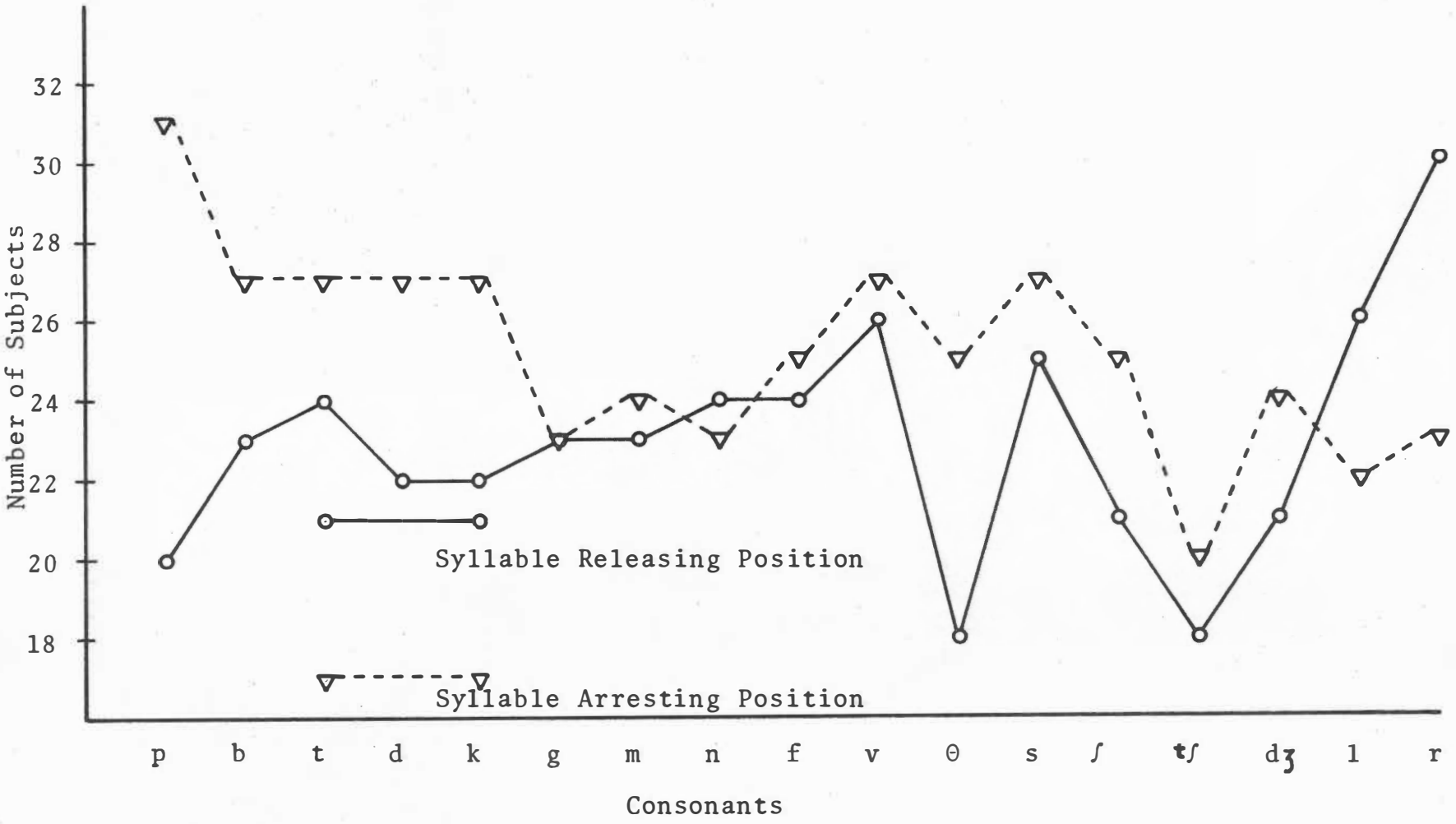

Figure 8. Number of subjects correctly producing the /z/ in syllable releasing and arresting positions for each phonetic context.

Table 15. Number and percent correct of /ʃ/ productions by preceding consonant (PC) in syllable releasing position and by following consonant (FC) in syllable arresting position.

Releasing Position			Arresting Position		
PC	Number	Percent Correct	FC	Number	Percent Correct
p	35	87.5	p	31	77.5
b	35	87.5	b	35	87.5
t	36	90.0	t	33	82.5
d	33	82.5	d	35	87.5
k	35	87.5	k	33	82.5
g	37	92.5	g	35	87.5
m	34	85.0	m	32	80.0
n	35	87.5	n	35	87.5
f	34	85.0	f	29	72.5
v	36	90.0	v	32	80.0
θ	33	82.5	θ	33	82.5
s	35	87.5	s	29	72.5
z	34	85.0	z	31	77.5
tʃ	33	82.5	tʃ	34	85.0
dʒ	34	85.0	dʒ	32	80.0
l	35	87.5	l	34	85.0
r	35	87.5	r	34	85.0

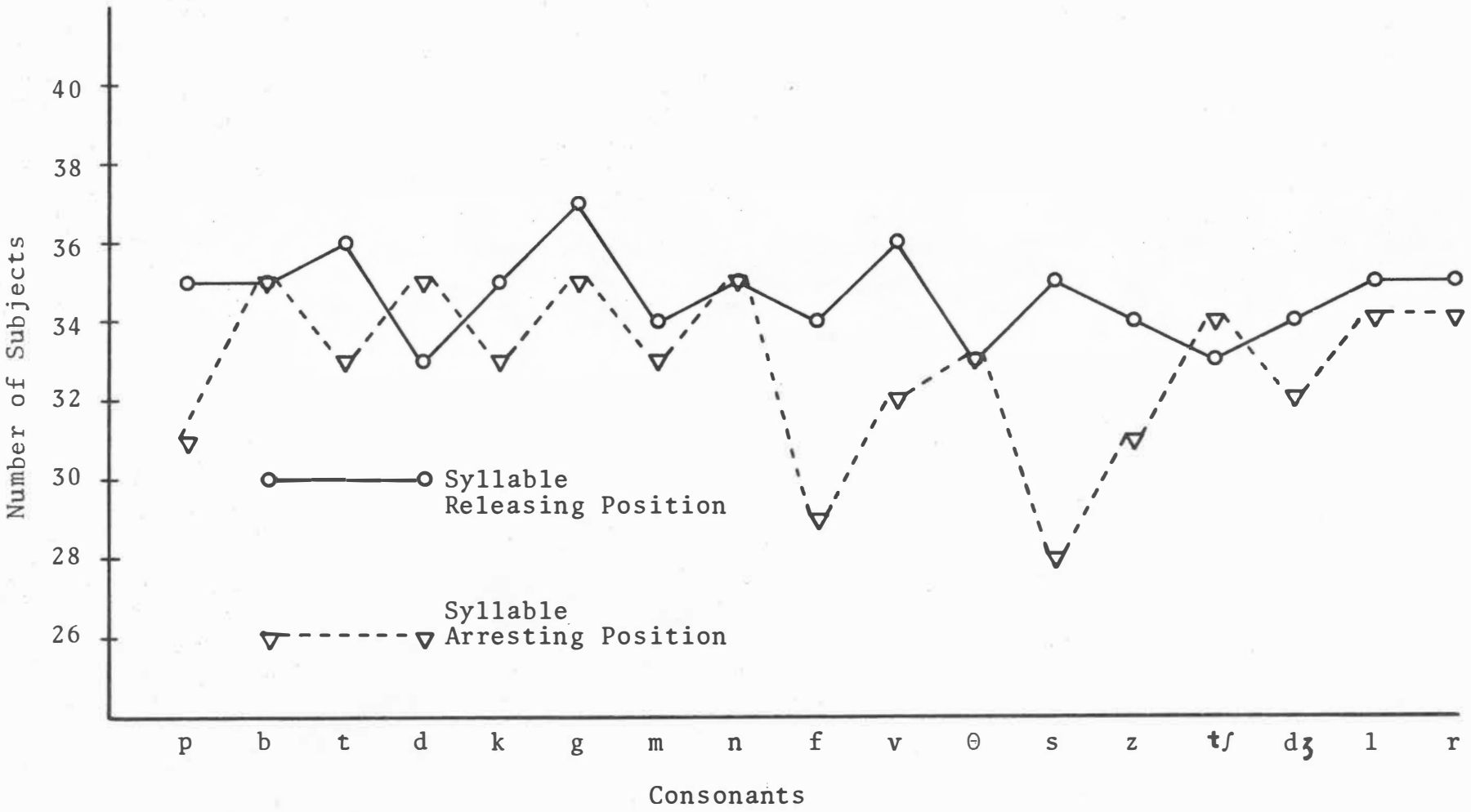

Figure 9. Number of subjects correctly producing the /ʃ/ in syllable releasing and arresting positions for each phonetic context.

Table 16. Number and percent correct of /ʧ/ productions by preceding consonant (PC) in syllable releasing position and by following consonant (FC) in syllable arresting position.

Releasing Position			Arresting Position		
PC	Number	Percent Correct	FC	Number	Percent Correct
p	38	95.0	p	39	97.5
b	39	97.5	b	37	92.5
t	38	95.0	t	39	97.5
d	39	97.5	d	37	92.5
k	40	100.0	k	38	95.0
g	39	97.5	g	38	95.0
m	40	100.0	m	40	100.0
n	39	97.5	n	39	97.5
f	40	100.0	f	36	90.0
v	39	97.5	v	38	95.0
θ	38	95.0	θ	38	95.0
s	39	97.5	s	36	90.0
z	39	97.5	z	36	90.0
ʃ	39	97.5	ʃ	36	90.0
ʤ	38	95.0	ʤ	37	92.5
l	38	95.0	l	39	97.5
r	40	100.0	r	40	100.0

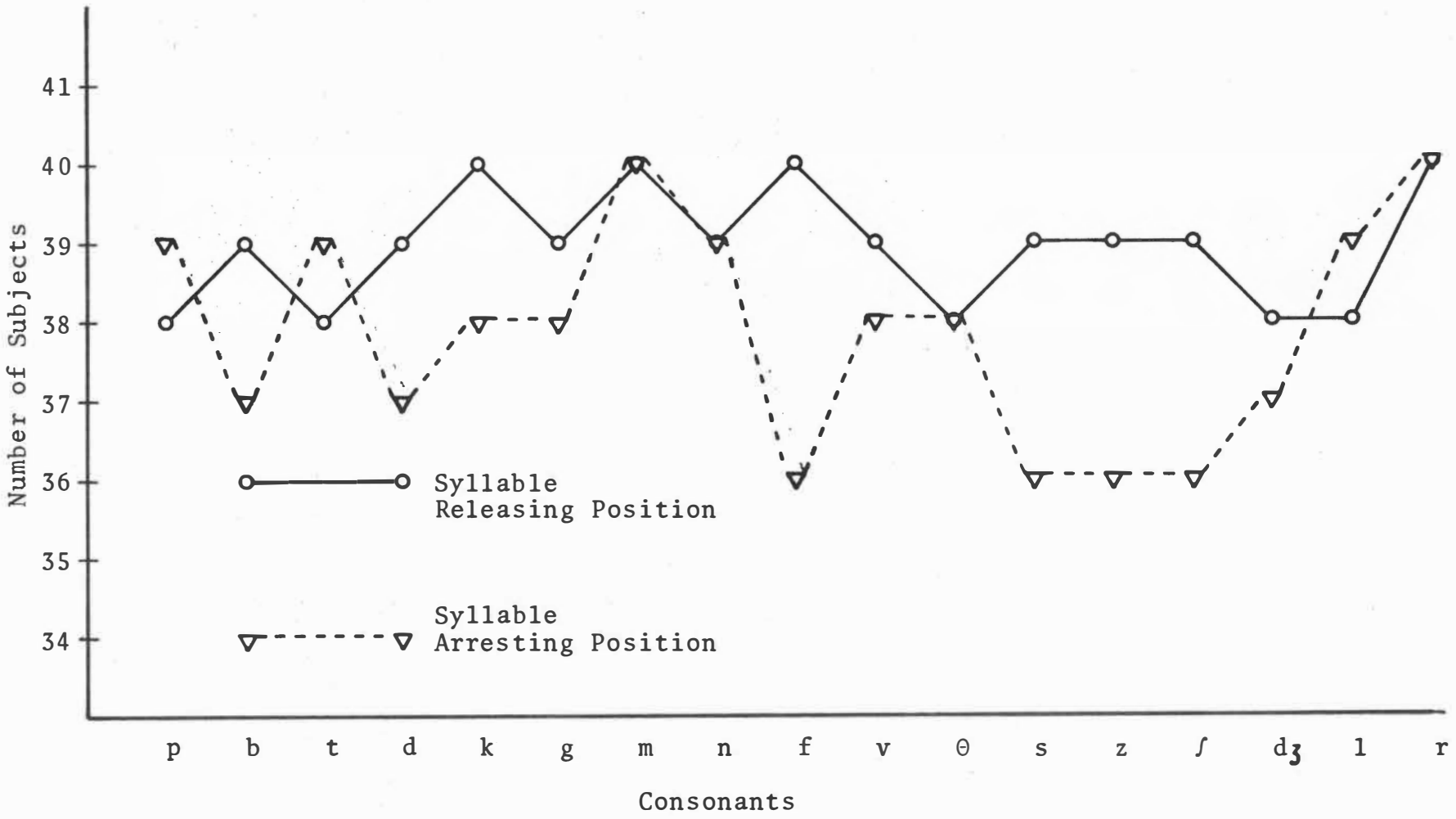

Figure 10. Number of subjects correctly producing the /tʃ/ in syllable releasing and arresting positions for each phonetic context.

Table 17. Number and percent correct of /dʒ/ productions by preceding consonant (PC) in syllable releasing position and by following consonant (FC) in syllable arresting position.

Releasing Position			Arresting Position		
PC	Number	Percent Correct	FC	Number	Percent Correct
p	32	80.0	p	33	82.5
b	29	72.5	b	35	87.5
t	33	82.5	t	36	90.0
d	30	75.0	d	35	87.5
k	31	77.5	k	36	90.0
g	32	80.0	g	36	90.0
m	31	77.5	m	36	90.0
n	28	70.0	n	36	90.0
f	29	77.5	f	37	92.5
v	26	65.0	v	36	90.0
θ	28	70.0	θ	36	90.0
s	28	70.0	s	37	92.5
z	28	70.0	z	32	80.0
ʃ	26	65.0	ʃ	37	92.5
tʃ	28	70.0	tʃ	33	82.5
l	30	75.0	l	39	97.5
r	28	70.0	r	37	92.5

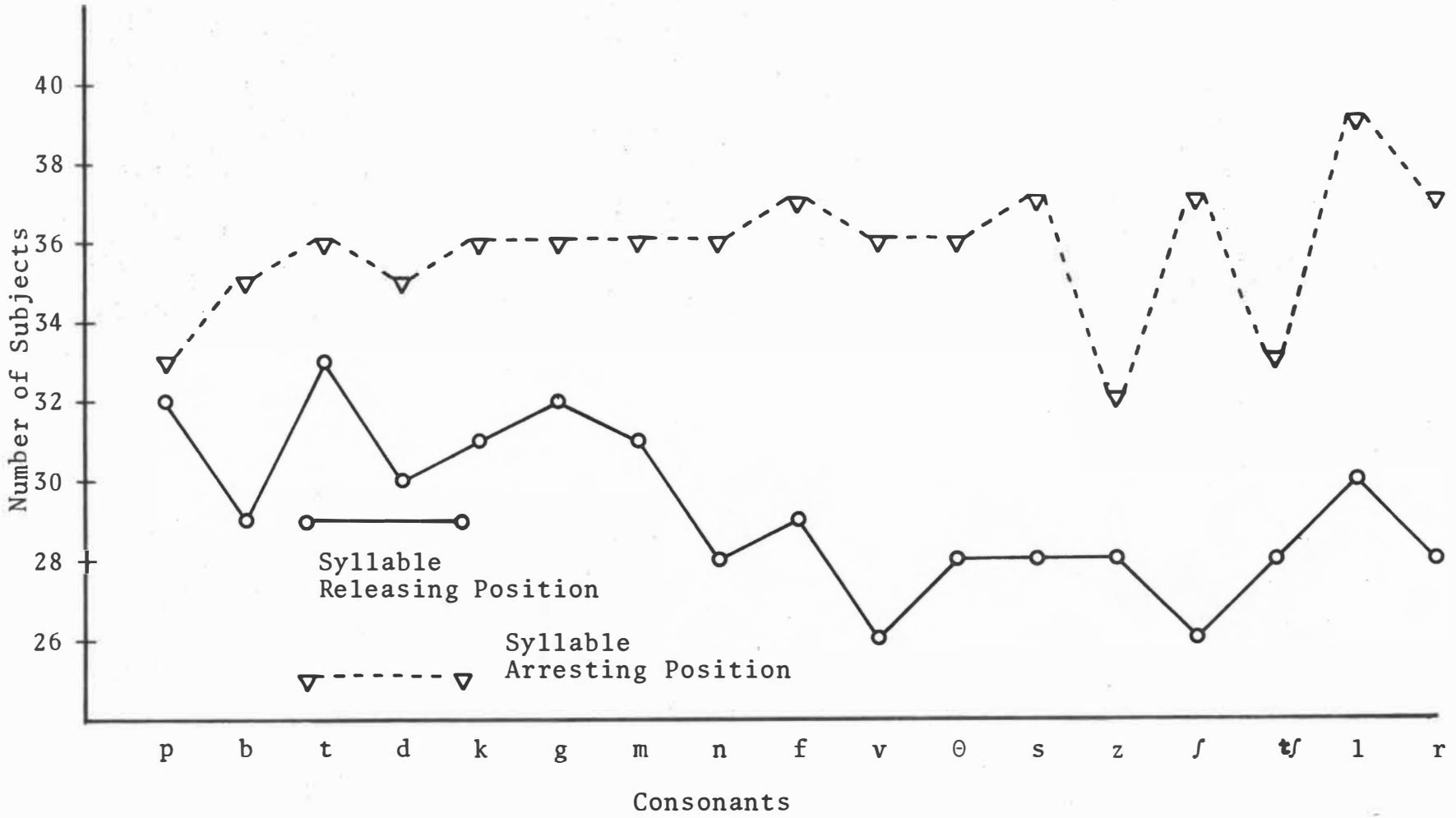

Figure 11. Number of subjects correctly producing the /dʒ/ in syllable releasing and arresting positions for each phonetic context.

VITA

Elizabeth Owens Kaplon was born in Dalton, Georgia, on August 17, 1950. She was graduated from Hillsborough High School in 1968. The following September, she entered the University of Florida in Gainesville, Florida, and in August, 1972, she received a Bachelor of Arts degree in Speech Pathology.

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She was married to Ted Kasper Kaplon of Knoxville, Tennessee, on December 19, 1976.