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A Durational Analysis of Inter- and Intra-Syllabic /s/ Blends

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A DURATIONAL ANALYSIS OF INTER- AND INTRA- SYLLABIC /s/ BLENDS.

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BY

AJIT HARISINGHANI

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CHAPTER I

INTRODUCTION

Disorders of articulation are the most frequently encountered among all speech disorders. They comprise the great bulk of all cases treated by speech clinicians in the public schools. Van Riper (1972) says that over 75 per cent of all speech problems are articulatory in nature. Powers (1971) estimated that between 75 and 80 per cent of all speech defectives in the school population are those classified as functional articulatory disorders. Since speech therapy deals largely with articulatory disorders, we should have at our disposal a test of articulation that is reliable and accurate. At present, there is a variety of articulation tests available and the clinician has to evaluate the accuracy of these tests and choose the one that he thinks will give the best picture of the subject's articulatory behavior.

There are two schools of thought concerning articulation testing: one recommends testing speech at the word level; while the other recommends testing dynamic or running speech. In most tests of articulation, it is assumed that the continuous flow of speech can be broken down and that these separated units have the integral characteristics that are independent of the contexts in which they occur. It has been

further assumed that these phonetic units are separable and therefore a suitable acoustical analysis would yield a single set of values for each, which would be adequate to specify the significant acoustical characteristics. This author believes that the time variation which is known to occur when sounds are spoken in context is important in the process of linking sounds together. This is an essential rather than an incidental characteristic. Curtis (1954) was among the first to challenge the assumptions enumerated above. He assigned greater significance to the kinematic features of speech sounds. He said that the transitional variations that result from the interaction of consecutive sounds are very important and deserve greater consideration. These assumptions need to be carefully examined and such an examination might prove that the case for the dynamic assessment of an individual's speech is strengthened. This is particularly true with respect to the analysis of consonants. It has been demonstrated by Oehman (1966) that there is considerable coarticulation between phones; that is articulatory characteristics that are involved in the production of one phone may be observed during the time segments assigned to other phones in the string. Coarticulation appears to be conditioned by various factors: including stress, rate of utterance, phonetic context and morphemic boundaries: (Lindblom, 1963; Stevens and House, 1963; Lehiste, 1962; and Oehman, 1966.)

Despite their complexity, all speech sounds are acoustically recognizable and spectrographically definable. Cooper (1950) says that the sonagraph is an accurate supplement to the auditory channel in the perception of speech sounds. He states that: " With the help of this instrument, sound waves are organized into a 'picture', so the complex sound patterns which we readily perceive as entities by the ear are so processed that they are also perceived by the eye; ie. through two separate modalities.".

Phonetic context has been described as " the totality of phonetic conditions that affect the production of a given speech sound" (Griffith and Miner, 1973). Stevens and House (1963) indicate that consistent changes in acoustical measurement are to be expected depending upon that particular vowel, and upon the voicing characteristics and the particular manner and place of production of the adjacent consonants. Stevens, House and Paul (1966), and Oehman (1966) have demonstrated coarticulation for consonant-vowel-consonant (CVC) and vowel-consonant-vowel (VCV) syllables in which vowels and consonants mutually influence each other in forward and backward positions over as many as two phonemes. Fujimura (1961) recorded the motion of articulators during speech production through high speed camera and found that there are extensive vowel-consonant coarticulations of lip and jaw configurations in the foward positions. Harris (1953) indicated that in ordinary conversational

speech, vowels and consonants are influenced by the sounds adjacent to them. All the above mentioned points support the need for the dynamic testing of articulation.

Stetson (1951) showed that the syllable is the basic phonetic unit. The core of every syllable is a vowel or vocalic sound and the consonants function only within their syllables. They initiate or arrest vocalic sounds. Thus the /k/ in 'because' is as much an initial sound as the /k/ in 'cause' or 'ofcourse'. Keenan (1961) said that the practice of labelling sounds as being in the initial, medial or final positions is very obscure. The term 'medial' is representative of the sound that is neither the first nor the last sound in the word. This concept does not consider the variety of phonetic events that occur between the ends of the words especially if they are long words. Van Riper and Irwin (1958) advise that the tester should consider the variability of various productions of consonants from word to word as used by individual speakers. Therefore, Keenan (1961) suggests that another system of classification should be employed which is more precise and definite. All consonants which begin and end words or phrases are external consonants and may be pre-vocalic or post-vocalic. Internal consonants (singles or blends) are those spoken within words or phrases; and they can be pre-vocalic, post-vocalic or inter-vocalic. Physiological studies also indicate that the phonetic context in which the syllable occurs influences its manner of articulation.

Stetson (1951) found that every syllable existed on a separate chest pulse (pressure); the pressure falls (decreases) between the syllable pulses thus establishing boundaries for individual syllables. Shohara (1939) found that different muscle movements occur during the production of a sound in different phonetic contexts. Stetson and Shohara also agree with other authors in that the nature of a pattern or context cannot be perceived by an analysis of its parts. Shohara observed that when a group of movements typical of an isolated consonant is combined with another consonant or vowel, the result is not the sum of the two movements but a new group and consequently a new sound. Spriesterbach and Curtis (1951) gave some more evidence that phonetic context is vital when they said that the individuals who misarticulated speech sounds did so inconsistently and that these inconsistencies were to be accounted for on a lawful basis. They are in part a function of the phonetic context in which the sometimes misarticulated sound occurs.

Stetson (1951) indicated that sounds are not essentially auditory but are uttered and perceived by kinesthetic clues from the vocal organs, and by auditory clues. All sensations that are associated with articulation movements contribute to the control of these movements. A detailed analysis of the perceptual and acoustic qualities of the defective sounds is extremely necessary if we are to have an accurate and reliable test of articulation. As regards blends, this

author feels that the present tests of articulation do not assess the acoustic and perceptual qualities of blend combinations as they occur in dynamic speech. This is important since an interesting inconsistency is shown in that the proportion of children making errors on the blends: /sk/,/str/,and /dr/ was found, by Roe and Millisen (1942) to be less than the proportion of children making errors on the single sound elements contained in them. This may indicate that some blends facilitate sound production. An accurate assessment of blends assumes even greater significance in light of the above findings.

From the clinical point of view, to look at phonetic contexts in which the individual consistently articulates the sound correctly is both feasible and advisable. As Van Riper and Irwin (1958), Curtis and Hardy (1959) and many others have stressed, a thorough phonetic analysis of misarticulations is valuable to an understanding of the problem and to planning of a remedial program. The first clinical use of this concept of combining effects of sounds was made by McDonald (1964) when he introduced his test of articulation. He examined combinations of 25 consonants and 10 vowels in depth using pictures as stimulus items. He, like Keenan (1961), employs the pre-vocalic and post-vocalic testing procedure for his Deep Test of Articulation. He tests blends by combining two words into one test word, i.e. 'house' and 'tie' become 'housetie'. The context /st/ is being tested. Garrett (1972) questions the validity of

this testing procedure: "McDonald's contention that a two-syllable utterance is an adequate sample of 'connected speech' is, however, open to question." (p. 951). The influence of syllabic stress in these two-syllabic words may inadvertently change the testing environment of the items. The compound noun 'housetie' is composed of two syllables. In testing the blend /st/ in this compound noun, McDonald hypothesized that he is testing this in one syllable. Thomas (1958) indicated that the stress in a compound noun would normally fall on the first element of the compound. Thus the stress and syllable division of 'housetie' would be 'house/tie'. In reducing the number of the very large possible phonetic contexts in which the sound may occur, McDonald made two assumptions:

> (1) The articulatory movements required for producing one type of context might be sufficiently similar to those required for producing another context that only one of them need be evaluated.
>
> (2) Since vowels are produced by relatively simple articulatory movements, it might not be necessary to study the influence of each vowel on the sound being evaluated.

He recognized that inter and intra-syllabic abution were not exactly similar; but he said that a study by Dininny (1963) had found that children who articulated the sound correctly in the inter-syllabic position also did so in the intra-syllabic position and those children who articulated the sound incorrectly did so in both positions.

This was his justification for considering only one position as a sufficient indicator of the accuracy of articulation of that blend. Justification for using the abutting combination is mainly based on the fact that the variety of abutting contexts far exceed the variety of inter-syllabic blends. In his attempt to decrease the staggeringly large number of possible phonetic contexts in the English language for an articulation test, he may have wrongly assumed that the articulatory movements employed in the production of one type of context might be sufficiently similar to those required for producing another context. It was hypothesized by this author that this is not so; that the articulatory movements in the production of blends in inter-syllabic combinations are not sufficiently similar to those required to produce the same blends in the intra-syllabic combinations.

The purpose of this investigation was to determine the adequacy of compound consonant sequences and abutting consonant blend sequences for deep testing articulatory ability for the /st/,/str/,/sk/, and /sp/ blends. The question posed here was whether or not there was any lapse of time between the articulation of the /s/ and /t/ sound components of the blend /st/ for example. And if there was, was there any significant difference between the time lapses with respect to that particular blend in the inter-syllabic and intra-syllabic combinations. The four /s/ blends named above were chosen because they are the most

frequently occuring ones.

CHAPTER II

PROCEDURE

Selection of Subjects:

Children with any functional disorder of articulation were excluded from this study. Those with severe organic involvements, such as cleft-palate or cerebral palsy; those who stutter; those with additional speech impairments such as voice disorders or a serious delay in language development were also excluded. So as to include only children with normal intelligence, those in Educable Mentally handicapped or exceptional ability classes were excluded. It was hypothesized that the exclusion of these children would result in a population of subjects with "average" intelligence. They had no observable hearing impairment as judged by their classroom teacher. They were all from the seventh grade of the Eastern Illinois University Laboratory School. They were all selected by their classroom teacher on the basis of the above named criteria. Each subject was administered the Griffith-Miner Phonetic Context Inventory (1973) for the four /s/ blends mentioned previously. Any subject who had one or more error was excluded from this investigation. The number of subjects (N) was set for twenty. There were ten boys and ten girls.

Selection of Stimulus Material:

The stimulus words were taken from the first 2,500 most frequently

occuring words from the Thorndike-Lorge list of 10,000 most frequently occuring words. The most frequently occuring /s/ blends are: (in rank order) /st/,/sp/,/str/ and /sk/. The McDonald Picture Test of Articulation tests these blends in inter-syllabic combinations in the following words:

house tie
house pipe
house cat

It does not test the blend /str/.

The four initial words selected for the present investigation were consistent with McDonald: i.e. 'house'. The stimulus words used were:

Set # 1	house take	(inter-syllabic)
	house stake	(intra-syllabic)
	stake	(intra-syllabic)
Set # 2	house pill	(inter-syllabic)
	house spill	(intra-syllabic)
	spill	(intra-syllabic)
Set # 3	house tride	(inter-syllabic)
	house stride	(intra-syllabic)
	stride	(intra-syllabic)
Set # 4	house cold	(inter-syllabic)
	house scold	(intra-syllabic)
	scold	(intra-syllabic)

Each stimulus word was printed in black ink on a 3 x 5 inch note card resulting in a total of twelve cards used for this test. These were placed in a ring binder to facilitate presentation. The word 'house' was presented

on the left hand card and the word 'take' was presented on the right hand side card. For the next trial, the word 'house' was presented on the left hand side card and the word 'stake' was presented on the right hand card. This procedure was followed for each of the four sets. Verbal instructions to each subject were:

> "You will see two cards flipped over and each card will have one word written on it. So there will be two cards with two words. Your job is to make 'one funny big word' by joining the two words. Remember, make 'one funny big word, without stopping between the two words. Ready?"

A training session preceeded the experimental session. The training words were as follows:

Practice Set # 1	cup ray	(inter-syllabic)
	cup pray	(intra-syllabic)
	pray	(intra-syllabic)
Practice Set # 2	tub rake	(inter-syllabic)
	tub brake	(intra-syllabic)
	brake	(intra-syllabic)

After the subject showed proficiency in the training session, he was allowed to proceed with the stimulus items and pronounce them without stopping in between them. Each subject was given one trial per combination resulting in three responses per subject per set. This gave a total of twelve responses per subject. A grand total of 240 responses was obtained for twenty subjects.

Instrumentation:

All experimental items were recorded on an Ampex tape recorder Model number 602 and reproduced on an Ampex reproducer Model number 602-2. Scotch brand magnetic tape, $\frac{1}{4}$ inch x 1200 feet, silicone lubricated was used at an operating speed of $7\frac{1}{2}$ inches per second (ips). A Unidyne unidirectional microphone Model number 556S was placed twelve inches away from each speaker. The recording level was kept constant for each speaker as evidenced by the displacement of the recording intensity level indicator on the tape recorder. All twelve responses of each subject were re-recorded on another tape to be used in case the original tape was damaged. From the Amper tape recorder, the signal for each response was passed into a Kay Electric Sound Spectrograph, Sona-Graph Model Recorder. Twelve sonagrams were obtained for each subject. The range switch was set for the frequency regions from 85 kilocycles to 6,000 kilocycles. The horizontal distance covered by one sonagram is 318.5 mm representing 2.4 seconds on the time scale. The band selector for the scanning filter for the present study was set for wide band (300 kilocycles). The shaping switch was set at the recommended HS position.

Measurement:

In all but six sonagrams, measurements were made of the distance between the observable end of the fill designating the end of the /s/

component of the blend and the begining of the spike of the /t/, /tr/, /p/ or /k/ component as the case may be. Measurements were made in millimeters correct to 0.5 mm. A scale was used to make these measurements. In the other six sonagrams, there was no clear cut end of the fill for the /s/ component and in these cases, judgement was made with reference to the point where the major fill terminated.

CHAPTER III

RESULTS AND DISCUSSION

The questions posed at the initiation of this study were:

(1) Was there any lapse of time between the articulation of the two sound components of the four /s/ blends tested (/st/, /str/, /sp/ and /sk/).

(2) And if there was, was there any statistically significant difference between the time lapses as they occurred in inter-syllabic and intra-syllabic contexts.

This chapter reports the results of the statistical analysis and interprets their implications.

Statistical Tool Employed:

An analysis of variance technique was used to answer the questions mentioned above. In this technique, the data are treated at once and a general hypothesis of no difference among the means of the various groups is tested. In this test of difference, the author was concerned with two variations: the variation of the group means from the total or grand mean i.e. the "between groups"variance; and the average variability of the scores within each group referred to as "within groups" variance. A test for significance of differences of the two types of groups was done by employing the F Test (Downie and Heath, 1965). There are some basic

assumptions underlying the use of the analysis of variance:

(1) The individuals from the various groups should be selected on the basis of random sampling from normally distributed populations;

(2) The variance in the subgroups should be homogeneous;

(3) The samples comprising the groups should be independent.

The first and third assumptions were met since the subjects were selected at random by the classroom teacher from a group of normal twelve year old children. The second assumption, homogeneity of variance, was tested through the Bartlett's test (Downie and Heath, 1965). This test yielded a Chi Square (Table 1) which was nonsignificant and therefore the variance was assumed homogeneous.

Because all the three assumptions were met, it was possible to employ the analysis of variance technique as the statistical tool and the results that were obtained are shown in Table 2. The F test was done to evaluate the null hypothesis of no difference between the three stimulus conditions and it showed that the F value of 1.42 was less than the value that was required for significance at the .05 level. The value needed for significance at the .05 level was 3.04. This value was obtained from the F table (Downie and Heath, 1965; Appendix V). This table is entered with the number of degrees of freedom for the greater mean square across the top and with the number of degrees of freedom in the lesser mean

TABLE 1

Bartlett's Test to check Homogeneity of Variance:

	a	b	c	d	e	f	g	h	i
	n	n-1	X	X^2	X^2/n	d-e	f/b	log g	bh
Group A	80	79	687.5	6484.75	5908.20	576.55	7.30	.86332	68.20
Group B	80	79	697	6711	6072.61	638.39	8.08	.90741	71.69
Group C	80	79	742.5	7478.75	6891.33	587.41	7.44	.87157	68.85

$j = (\Sigma c^2) = 4524129$ $\quad k = j/\Sigma a = 1885054$ $\quad l = \Sigma f/\Sigma b = 7.60$ $\quad m = \log l = .88081$

Bartlett's : $\chi^2 = 2.3026 \left[(\Sigma b)\, m - \Sigma i\right] = 2.3026 \left[(237)\ .88081 - 208.74\right] = .02$

This Chi Square of .02 is not significant, therefore we can assume that the population was homogeneous.

TABLE 2.

Analysis of Variance: Table of Results:

Source of Variation	d_f	Sum of Squares	Mean Square
"Between Groups"	2	21.60	10.80
"Within Groups"	237	1802.36	7.60
Total	239	1823.96	

The F Test:

$$F = \frac{\text{mean square for "between groups"}}{\text{mean square for "within" groups "}}$$

$$= \frac{10.80}{7.60}$$

$$= 1.42$$

This is less than the required 3.04 value and therefore we accept the null hypothesis.

square on the left-hand side. Since the degrees of freedom for the greater mean square was 2 and the degrees of freedom for the lesser mean square was 237, the value of 3.04 was obtained by going over to 2 and down to 237 in the table.

Since the null hypothesis was accepted, it was assumed that there were no statistically significant differences between the time lapses as they occurred in the blend elements in inter-syllabic and intra-syllabic contexts. This non-significant F might indicate that though perceptual differences may exist in the articulations of the four /s/ blends tested, these perceptual differences are not manifested in durational differences. This non-significant F might also be a result of some other factors. There was a possibility that between and within groups, the subjects behaved in different ways but that pooling subject scores to compare mean differences might have obscured those differences. A visual scanning of the raw scores was done and it showed that:

(1) "between groups", in only five of the eighty sets of raw scores, were the differences in the time lapses for the inter-syllabic and intra-syllabic contexts greater than five millimeters;

(2) "within groups", an interesting inconsistency was apparent: in all but thirteen of the sixty sets of four responses for the four blends in the inter-syllabic and intra-syllabic contexts, the time lapse that occurred for the blends /sp/ and /sk/ was consistently greater than the time lapse for the

/st/ and /str/ blends. In this case of "within groups", it is possible that the differences cancelled themselves out so that in the final analysis, they were not considered.

In an effort to explore further possible differences, separate analyses of variance were computed for the three stimulus conditions for each blend. A total of four analyses of variance were computed. The resulting F values are listed in Table 3.

Table 3.-- Analyses of Variance: Table of Results:

Blend	F value
/st/	.60
/str/	.40
/sp/	1.88
/sk/	.67

All the F values were non-significant at the .05 level. This was interpreted to mean that no statistically significant differences existed between the three stimulus conditions for each blend.

Age of the subjects is an important factor on which the reliability and validity of the results obtained may depend. In this study, the twenty

subjects used were twelve year old children with 'normal' intelligence. The instructions were worded in a language simple enough for them to understand. They were given two trials so that they could familiarize themselves with the task that was expected of them. Only after the successful completion of the two trials were they allowed to proceed with the actual test items. These conditions minimized incorrect interpretation of instructions and therefore, the values obtained for the four /s/ blends tested can be generalized to a similar population. If younger children are used in a similar study, it was hypothesized by this author that the null hypothesis of no difference between the time lapses in inter-syllabic and intra-syllabic /s/ blends would still be valid. However, there may be a larger time lapse interval between the two sound components in either context. This may be due to the fact that in younger children, the articulators may not have acquired the ability to abut the two words together without stopping in between them. The results of this study are not being generalized to other blends. From the results obtained through the analysis of variance technique, there was no statistically significant difference between the time lapses that occur between the articulations of the two sound components of the four /s/ blends tested in the two contexts. However, perceptually, a clinician just 'knows' that the difference is there because he can clearly 'hear' it. The results of this study may possibly be indicating that the differences we perceive might be due to factors

other than a time factor consideration. It remains to be investigated just what these other factors might be. There is also a strong possibility that the human ear is a highly sensitive mechanism which can perceive even slight differences which apparently the sound spectrograph is unable to.

Given the technical ability, it would be desirable to make a perceptual analysis of the blends in the two contexts. To do this, one might have to splice out that particular blend and place it on another tape so that the judges are not influenced by the clues from the word context that the blend occurred in. The differences were obvious and this aspect calls for further investigation.

Implications:

With respect to the McDonald Deep Test of Articulation:

The premise of the McDonald Deep Test of Articulation is that the production of the sound element is strongly influenced by the phonetic context in which the sound is placed. McDonald (1964) has described speech as a series of overlapping, ballistic-type movements of the articulators in which single sounds as well as words are blended into a total framework of the utterance. This study has substantiated Dininny's (1963) statement that though there are differences between the abuttions of consonants when they occur inter-syllabically and

intra-syllabically, such dufferences are not so vital that an articulation test that did not consider both contexts would be counted as invalid. Garrett (1972), while questioning the validity of McDonald's contention that a two-syllabic utterance was an adequate sample of 'connected speech', also indicates that reliability depends mainly on intra-judge reliability. He supports test saying that it includes a more controlled and representative sample of articulatory behaviour than the conventional three position tests. Further, he states that McDonald has probably as valid a test as any today. This author agrees with Garrett. The Deep Test is a start in the right direction.

Whether the results of this study for /s/ blends would be valid for other blends as well, remains an unanswered but empirical question. A design similar to that of this study is being replicated by Wasson (1973).

CHAPTER IV

SUMMARY AND CONCLUSIONS

The purpose of this investigation was to determine the adequacy of compound consonant sequences and abutting consonant sequences for deep testing articulatory ability for the /st/, /str/, /sp/, and /sk/ blends. The question posed was: Was there any lapse of time between the articulation of the two sound components of these four /s/ blends; and if there was, was this difference statistically significant when the blends were tested in inter-syllabic and intra-syllabic contexts. The four /s/ blends mentioned above were chosen because they were the most frequently occuring ones.

Twenty subjects (ten boys and ten girls) were selected at random from the seventh grade of the Eastern Illinois University Laboratory School. They were 'normal' subjects with no speech or hearing problems. Stimulus words were :

Set # 1	house take	(inter-syllabic)
	house stake	(intra-syllabic)
	stake	(intra-syllabic)
Set # 2	house tride	(inter-syllabic)
	house stride	(intra-syllabic)
	stride	(intra-syllabic)
Set # 3	house pill	(inter-syllabic)
	house spill	(intra-syllabic)
	spill	(intra-syllabic)
Set # 4	house cold	(inter-syllabic)
	house scold	(intra-syllabic)
	scold	(intra-syllabic)

The subjects were asked to say the two words together without stopping in between them. They were allowed to proceed with the test items after they showed proficiency in the task as evidenced by the two practice sets that were administered. A total of twelve responses per subject were recorded on an Ampex tape recorder and a grand total of 240 responses were recorded for the twenty subjects. These were fed into a sound spectrograph and sonagrams were obtained for each of the 240 responses. Measurements were made between the observable end of the fill designating the end of the /s/ component of the blend and the begining of the spike of the /t/, /tr/, /p/ or /k/ component as the case may be. Measurements were made in millimeters using a scale correct to 0.5 mm.

An analysis of variance technique was used to test a general hypothesis of no difference among the means of the various sub-groups. The F test was done to test the significance of the differences of the two types of groups; i.e. "between groups" and "within groups". The F value obtained was 1.42 which was less than the 3.04 value that was required for significance.

The results of the statistical analysis showed that there were no differences in the time lapses between the two components of the /s/ blend as they occurred in inter-syllabic and intra-syllabic abuttions. To further explore the validity of the results obtained, separate analyses

of variance were computed for each of the four /s/ blends and the results of these analyses supported the fact that there was no statistically significant difference between the articulations of the two sound components of these four /s/ blends as they occurred in inter-syllabic and intra-syllabic contexts.

Conclusions:

Three conclussions were drawn from the results obtained:

(1) This investigation provides no evidence that inter-syllabic and intra-syllabic blends are different with respect to the time lapse that occurs between the articulations of the two blend components in the inter-syllabic and intra-syllabic contexts;

(2) It may be possible that the human ear is a much more sensitive organism than the sound spectrograph, and it may pick up differences which the spectrograph is unable to. This accounts for the fact that the blends when perceived by the ear in the two abutting contexts appear to be different;

(3) Since inter-syllabic and intra-syllabic contexts are similar, a test like the McDonald Deep Test of Articulation; which does not consider blends in both contexts, is a valid test of articulation. This procedure of articulation testing appears to be a rational way to proceed.

BIBLIOGRAPHY

Cooper, F.S., "Spectrum analysis." , Journal of the Acoustical Society of America, 22, (1950) 761-762

Curtis, J.F., "The case for dynamic analysis in acoustic phonetics.", Journal of Speech and Hearing Disorders, 19, (1954) 147-157

Curtis, J.F. and Hardy, J., "A phonetic study of misarticulations of /r/." Journal of Speech and Hearing Research, 2, (1959) 244-257

Dininny, D.H., Unpublished Master of Education research paper, University Park, Pennsylvania: The Pennsylvania State University, (1963)

Downie, N.M. and Heath, D.W., Basic Statistical Methods, sec. ed., New York: Harper and Row, (1965)

Fujimura, O., "Bilabial stop and nasal consonants: A motion picture study and its acoustical implications, " Journal of Speech and Hearing Disorders, 4, (1961) 233-247

Garrett, Edgar in Buros, Oscar, Mental Measurements Yearbook, New Jersey: The Gryphon Press, 2, (1972) 951

Griffith, J. and Miner, L.E., " A phonetic approach to articulation therapy." Paper presented at ISHA Convention, Eastern Illinois University: Charleston, Illinois. (1973)

Griffith, J. and Miner, L.E., Syllable Training Manual. Chicago: Bell and Howell, (1973)

Harris, C.M., "A study of the building blocks of speech." Journal of the Acoustical Society of America, 25, (1953) 962-969

Keenan, J., "What is medial position?" Journal of Speech and Hearing Disorders, 26, (1961) 171-174

Lehiste, I., "Acoustical characteristics of selected English consonants." Commun. Sci. Lab. Rep. No. 9, University of Michigan, (1962)

Lindblom, B., "Spectrographic study of vowel reduction." Journal of the Acoustical Society of America, 35, (1963) 1773-1781

McDonald, E.T., Articulation Testing and Treatment: A Sensori Motor Approach, Pittsburg: Stanwix House, (1964)

Oehman, S.E.G., "Coarticulation in VCV utterances: Spectrographic measurements." Journal of the Acoustical Society of America, 39, (1966) 151-168

Powers, Margaret., "Functional disorders of articulation: Symptomatology and etiology," Handbook of Speech Pathology and Audiology, ed. by Lee Travis, New York: Appleton-Century-crofts, (1971)

Roe, V. and Milisen, R., "The effects of maturation upon defective articulation in the elementary grades," Journal of Speech and Hearing Disorders, 7, (1942) 37-50

Shohara, H., "Significance of overlapping movements in speech." Proceedings of the Second Biennial Central Zone Conference of the American Society for the Hard of Hearing, St. Louis, Missouri, May 1939

Spriestersbach, D.C. and *Curtis, J.F.*, "*Misarticulation and discrimination of speech sounds.*" Quarterly Journal of Speech, 37, (1951) 483-391

Stetson, R.H., Motor Phonetics: A Study of Speech Movements in Action. Amsterdam: North-Holland Publishing Company, (1951)

Stevens, K.N. and House, A.S., Perturbations of vowel articulations by consonantal context: An acoustical study." Journal of Speech and Hearing Research, 6, (1963) 111-128

Stevens, K.N.; House, A.S.; and Paul, A.P., "Acoustic description of syllable nuclei: An interpretation in terms of a dynamic model of articulation," Journal of the Acoustical Society of America, 40, (1966) 123-132

Thomas, C., An Introduction to the Phonetics of American English, New York: The Ronald Press Company, (1958)

Van Riper, C., Speech Correction: Principles and Methods, 5th.ed., New Jersey: Prentice-Hall, Inc., (1972)

Van Riper, C. and Irwin, J.V., Voice and Articulation, New Jersey: Prentice-Hall, Inc., (1958)

Wasson, J. "An acoustic and perceptual analysis of inter- and intra-syllabic /r/ blends." Proposed master's thesis, Eastern Illinois University, Charleston, Illinois (1973).