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A Phonetic Context Approach to Articulation Therapy for /r/

Karen W. Ettinger
Eastern Illinois University

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A PHONETIC CONTEXT APPROACH TO ARTICULATION THERAPY FOR /r/

(TITLE)

BY

Karen W. Ettinger

THESIS

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DEDICATION

This project was made possible through the support and constant encouragement of my parents, Mr. and Mrs. Harold R. Weibel; my brother, John; my sister, Ann; and my husband, Bill. It is, in part, dedicated to them.

In recognition of my grandparents' devotion to and sincere concern for the field of education, this thesis is also dedicated to them, Dr. and Mrs. J. Edgar Stonecipher.

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CHAPTER I

INTRODUCTION

The speech defective child is often confronted with the task of modifying misarticulations to meet acceptable standards of phoneme production. It is the job of the speech clinician to aid him in this task. Traditional approaches to articulation therapy suggest beginning with the particular phoneme in isolation, then nonsense syllables, and then words, leading into sentences and conversation (Van Riper, 1963).

Templin (1957) questioned the value of words in the study of speech sounds. "Frequency and type of error in articulation varies with the type of sound and its position in the word" (p.60). She felt that analysis of the sound in the syllable, rather than in the word, would yield more useful information. By disregarding a sound as functioning in an initial, medial, or final position of a word, one focuses attention on the function of the sound within the syllable (Keenan, 1961). Keenan stated that sounds differ within syllables in regard to three speech elements: namely, phonetic context, syllabic stress, and syllabic position. Keenan and

McDonald (1964) agree that deviant phonemes should be regarded as being either releasing or arresting elements of syllables rather than as being in one of three positions in a word.

By emphasizing the importance of the syllable, attention is focused upon phonetic context analysis. Analysis of those syllables in which a deviant sound appears identifies those phonetic contexts which occur the most frequently with production errors. Such information would be helpful in studying "the deviant (nondevelopmental) feature patterns or rules that actually occur...and the actual incidence of each of these patterns" (Leonard, 1973). A therapeutic implication from this would be that if a more frequently occurring phonetic context were in error, attempts to correct it should be made before other contexts so that the child will have increased opportunity for practice. In addition, if an error is present in a frequently occurring phonetic context, improved articulatory skills will be more readily apparent.

Spriestersbach and Curtis (1951) noted that "inconsistencies in speech sound production can hardly be attributed to chance. We must assume, therefore, that certain variables are operating in a systematic, lawful fashion" (p. 485). It may be proposed that four lawful, systematic variables of

speech sound production are: 1) phonetic context; 2) frequency of occurrence; 3) syllabic position; and 4) syllabic stress. Errors in phoneme production may vary in regard to the phonetic environment of the syllable, the frequency with which that context occurs, the phoneme's function in releasing or arresting the syllable, and the stress of the syllable being accented or unaccented.

The present study is concerned with the analysis of /r/ productions in three different phonetic contexts. Curtis and Hardy (1959) in "A Phonetic Study of Misarticulation of /r/", found that phonetic context accounts for the function of the sound in the syllable. They rank ordered the correct productions as they were influenced by phonetic context. The resulting order from the most often correct to the least often correct was /r/, /ɝ/, /ɚ/. In the results of their study, Curtis and Hardy cited four findings which justify research in the field of phonetic context and articulation therapy.

> 1. ...the differences in response patterns shown in this study suggest underlying differences in articulatory movements which may need to be considered in relation to the problem of their appropriate phonemic classification.
>
> 2. ...inconsistency of misarticulation is common in the speech of children with functional misarticulations...with respect to the various types of /r/ this inconsistency is systematic

and can be related to a certain extent to the phonetic context in which the /r/ occurs.

3. ...thorough phonetic analysis of articulatory defective speech may be valuable in understanding the problem and planning a corrective program. A detailed analysis would seem indicated both to determine the specific type of sounds which are misarticulated and to reveal phonetic contexts which facilitate correct articulation for the individual case.

4. ...phonetic context is an important factor in the articulatory process and suggests that there may be a need to re-examine the common assumption that clinical retraining procedures should usually begin with isolated sounds on the presumption that they are more readily articulated (pp. 255-256).

It is indeed evident that studies evaluating specific phonemes, and the relationship between phonetic context and articulation therapy are necessary. Effective therapy techniques for correcting defective functional articulation errors of school children are sought by speech clinicians. It appears that phonetic context analysis of speech sound errors is a therapy technique worthy of investigation.

STATEMENT OF PURPOSE

The purpose of this study is to describe the articulatory responses of fifteen children with inadequate /r/ productions in three phonetic /r/ contexts: /ɛr/, /rɪ/, /rɛ/. The children were exposed to training in the production of these contexts as they appeared in the words "bear", "every", and "red". The criterion measure for analysis was determined by the response ratio (RR) of the number of reinforced responses (Rr) to the number of total responses (R). The response ratio (RR), written as #Rr/#R, was used to answer the following questions concerning the three phonetic /r/ contexts.

QUESTIONS

1. Is there a statistically significant difference in the response ratio (RR) of the subjects to the three most frequently occurring phonetic /r/ contexts?
2. With regard to ease or difficulty of phoneme acquisition, what is the resulting rank order of the three most frequently occurring phonetic /r/ contexts following articulation therapy?

CHAPTER II

REVIEW OF RELATED LITERATURE

SPEECH SOUND ACQUISITION AND DEVELOPMENT

Poole (1934) was the first to classify phoneme acquisition according to chronological age. In so doing, she found that from 2.5 to 5.5 years of age, boys and girls develop articulatory proficiency at about equal rates. "At 6½ years, girls approach efficiency in articulation, while the boys require another year, until 7½ years of age to reach the same degree of perfection" (p. 159). Templin (1957) reached the same basic conclusion in her revision of Poole's norms with the exception that maturity of articulation skills is reached at around 8 years of age, with boys requiring an additional year. While Poole stated articulatory proficiency for girls to be at 6.5 years of age and boys at 7.5 years of age, she made the point that "not until 7½ are they able to articulate in their speech the sounds of z,s,r,th..." (1934, p. 159). It appears, according to this latter statement, that Poole and Templin are actually in close agreement for the age norm

of speech sound maturity.

Sander (1972) stated that normative age scales for speech sound acquisition tend to "represent upper age limits rather than average performance, and stress-sound mastery in all word positions as opposed to customary usage" (p. 55). Sander maintained that age profiles which have been previously developed for phoneme production, are not used by clinicians with the researchers' criteria for sound-mastery in mind. For example, Templin (1957) cites 4.0 years as the age for proficiency of the /r/ according to a criterion of 75 per cent correct productions by her subjects. Poole (1934) cites 7.5 years as the age of proficiency for the /r/ with the same criterion as Templin. The Hall-Healey (1963, 1964) studies cite the ages of 7.0 years for boys and 6.0 years for girls as the proficiency ages for /r/ productions, according to a 90 per cent correct criterion of correct production. Sander's point was that he feels age norms for consonant development are too arbitrary. In setting up the norms, the definition of speech sound mastery should be changed to that of customary production. That is to say, a child should be considered as having learned a sound when he "is producing a sound more often than he is misarticulating or omitting it" (p. 56), rather than

when he correctly produces the sound in all three positions of words with consistency.

Within the past three decades, research concerning misarticulation of the /r/ phoneme within the rank ordering of the most frequently misarticulated phonemes has been subject to great variability. Van Riper (1938), in a study of sixty subjects ages eight to twenty-nine, listed the nine most frequently misarticulated single consonant sounds in the following order: /s/, /r/, /l/, /tʃ/, "th" (no identification as to voicing), /k/, /g/, /f/, /v/. Hall (1938) ranked the eight frequent phoneme errors as /s/, /z/, /ʃ/, /tʃ/, /dʒ/, /ʍ/, /θ/, /r/. Roe and Milisen (1942) ranked the /r/ as thirteenth out of the twenty-five most frequently defective sounds. The rank order being: /z/, /ʍ/, /θ/, /dʒ/, /d/, /s/, /g/, /ð/, /v/, /t/, /b/, /tʃ/, /r/, /k/, /ʃ/, /f/, /p/, /l/, /ŋ/, /w/, /st/, /str/, /sk/, /dr/, /fl/. Pendergast, et al., (1966) ordered the misarticulations in the order of greatest number of errors as found on the screening test of 15,255 first grade children. Their listing reads: /s/, /θ/, /z/, /ð/, /r/, /v/, /ʃ/, /l/, /tʃ/, /dʒ/, /f/, /k/, /g/. In the Roe and Milisen study (1942), the /r/ phoneme was not mentioned as one of the ten most frequently misarticulated sounds.

Most recent is the work done by Griffith and Miner (1973) concerning phonetic context and articulation therapy. By reviewing past research on the frequency of misarticulated phonemes and by applying their clinical insights based upon experience, they offer the following list of the nine speech sounds which are most often in error: /r/, /ɝ/, /ɚ/, /l/, /s/, /z/, /ʃ/, /tʃ/, /dʒ/. Table 1 illustrates the frequently misarticulated phonemes as reported by the above cited studies.

The studies cited do not list the most frequently misarticulated phonemes in similar rank orders. The between-study discrepancies are due, in part, to five variables. These sources of variance are: 1) the age range of the samples; 2) the testing instrument used with each sample; 3) the criterion for correct production set for each sample; 4) the sex differences in relation to performance; and 5) the sample size.

Poole (1934) and Templin (1957) found that up until the fourth grade, children improve their articulation skills without therapy. Saylor (1949) and Roe and Milisen (1942) found only slight or inconsistent improvement in speech sound proficiency occurred beyong grade three or four. Research by

TABLE 1.--Rank Order of the Most Frequently Misarticulated Phonemes as Reported by Five Studies

Van Riper (1938)	Hall (1938)	Roe and Milisen (1942)	Pendergast, et al. (1966)	Griffith and Miner (1973)
/s/	/s/	/z/	/s/	/r/
/r/	/z/	/ʍ/	/θ/	/ɝ/
/l/	/ʃ/	/θ/	/z/	/ɚ/
/tʃ/	/tʃ/	/dʒ/	/ð/	/l/
"th"	/dʒ/	/d/	/r/	/s/
/k/	/ʍ/	/s/	/v/	/z/
/g/	/θ/	/g/	/ʃ/	/ʃ/
/f/	/r/	/ð/	/l/	/tʃ/
/v/		/t/	/dʒ/	
		/b/	/f/	
		/tʃ/	/k/	
		/r/	/g/	
		/k/		
		/ʃ/		
		/f/		
		/p/		
		/l/		
		/ŋ/		
		/w/		
		/st/		
		/str/		
		/sk/		
		/dr/		
		/fl/		

Williams (1971) showed that the number of production errors in a child's speech decreases as grade level increases, especially between the first and fourth grades.

According to the Roe and Milisen (1942) study, the consonant /r/ ranks thirteenth out of the twenty-five most frequently occurring defective phonemes. Of all the children they tested, 2.8 per cent of the fourth graders produced defective /r/ sounds, 5.2 per cent of the fifth graders remained in error, and 3.3 per cent of the sixth graders had misarticulations of the /r/. They found that irrespective of the type of /r/ error or location of that error in a word, increased chronological age was not necessarily a criterion for corrected productions. However, they did find substitutions to be the most frequent error, decreasing with an increase in chronological age. As the child grew older, it seemed that he attempted to spontaneously correct his production errors. The result was that older children presented more phoneme distortions.

It is interesting to note that "a surprising finding is that the error rates of several phonemes (/z/, /r/, /l/, /θ/, /s/, and /v/) increase markedly from the first to second grade" (Williams, 1971, p. 47).

Based upon a nation wide survey with responses from 705 clinicians, Bingham (1961) determined that 81 per cent of the public school speech clinicians' caseloads consist of articulation problems. Powers states that "it is safe to say that functional articulation defectives represent between 75 and 80 per cent of all speech defectives in the school population" (Travis, 1971, p. 839). Schneider (1973) cites the Soutwest Regional Laboratory for Research and Development as reporting that misarticulations of the /r/, /s/, /l/, and /θ/ phonemes comprise 80 per cent of the caseloads. This 80 per cent figure was derived from a survey of 949 speech clinics within the United States.

ZIPF'S LAW

"Probably the most striking feature of words is difference in length" (Zipf, 1935, p. 20). Words are comprised of single-phoneme and multi-phoneme sequences. Zipf advocates that this difference in word length is significant. He states, "the length of a word tends to bear an inverse relationship to its relative frequency" (Zipf, 1935, p. 38). This is Zipf's Law of Abbreviation. Stated more simply: shorter words are used more frequently.

Zipf's Law has remarkable utility for the speech and language clinician. It reveals the "orderliness of the frequency distribution of words in the speech stream" (Griffith and Miner, 1973, p.2). The words can be rank ordered according to their frequency of occurrence. The phonetic contexts of these words can then be subjected to rank ordering. It is logical to assume, then, that if shorter words occur most often, the phonetic contexts found in these words also appear with greater frequency. Valuable therapy information lies in knowing which phonetic contexts appear most frequently in the speech of children.

PHONETIC CONTEXT

Phonetic context has been defined as "the totality of phonetic conditions that affect the production of a given speech sound" (Griffith and Miner, 1973, p.5). Zipf's Law implies that phonetic context, as well as words, can be rank ordered in terms of their frequency of occurrence. Zipf also proposes that the frequency with which phonemes occur determines their complexity of production in an inverse relationship. Zipf arrived at this conclusion, in part, from Grassman's Law of Haplology (Zipf, 1935).

Grassman's Law states that in language there is a tendency for "phonemes or phoneme-groups to become dissimilated under too great proximity" (Zipf, 1935 p. 85). While Zipf's conclusion is not a strict interpretation of Grassman's Law, it does seem reasonable that, from a therapy standpoint, the more frequently a correct production is attempted the easier the articulatory skill becomes. This conclusion is supported by Leonard and Ritterman (1971). And in conjunction with the most frequently occurring words, the availability of the phonetic context under correction provides the child with increased opportunity for communicative success. The apparent severity of the defective speech pattern is thereby reduced. The complexity of the articulatory movement is decreased as a function of frequency of occurrence of the phonetic context.

Buck (1948) and Spriestersbach and Curtis (1951) found that there was a systematic relationship between phoneme errors and the speech sound environment in which they occurred. In both studies, the conclusion was drawn that more intensive research should be done regarding phonetic context and articulation therapy. The work by Curtis and Hardy (1959) provides substantial support for such further investigation.

McDonald (1964) supports phonetic context research, but

not only from the standpoint that speech sound inconsistencies need analysis; but, he also feels that those contexts which are consistently produced correctly have to be identified. McDonald was instrumental in developing phonetic context testing for articulation therapy.

Schneider (1973) summarizes a thesis-in-progress which deals with the hypothesis that the /r/ phoneme develops in a systematic fashion through a series of phonetic contexts. Gresch and Payne studied this hypothesis by testing 283 children, ages three to eight years, with the McDonald Deep Test of Articulation. Their results showed that the mean errors per age group significantly decreased as age increased. They failed to mention, however, if the decreased errors due to increased age occurred for all /r/ contexts or only for certain individual /r/ contexts. By rank ordering the phonetic contexts according to frequency of errors, the most facilitating /r/ contexts for therapy were /rs/, /rθ/, and /rz/; while the least facilitating were /ɔr/, /mr/, and /lr/. The correction of misarticulated /r/ productions was found to be the most successful through final blend contexts. This was determined from the data that revealed a vowel-/r/-consonant combination was found to have fewer errors throughout the popu-

lation than a consonant-/r/-vowel combination.

McDonald (1964) set up his deep test on the premise that running speech may be adequately represented in a two-syllable sequence. As pointed out by Peterson (1972), this Deep Test could be greatly enhanced "if there were comparative data, in terms of percentage of expected correct responses for an age or in terms of rank ordering of the difficulty of contexts in which the sounds are to be tested" (p. 952). Griffith and Miner (1973) stated that of the 46 /r/ contexts in the first 1000 most frequently occurring words of first and second graders, McDonald's Deep Test only lists nine /r/ contexts. Griffith and Miner, however, viewed the influence of syllabic stress in their analysis of context, while McDonald did not.

In phonetic context analysis, the phoneme is described in relation to the vowel position, and the function of the phoneme as a single or blend. Of the researchers cited, a general conclusion is drawn that correction of the /r/ is facilitated through /r/ blends. Schneider (1973) supports this conclusion.

> It is of interest to note that the blend contexts /pr/, /dr/, /str/, /tr/, /dr/, /rθ/, and /θr/ were all produced correctly more often than any single context. This may indicate that these blends are more stimulable in children. Consequently, /r/ ar-

> ticulation therapy should be initiated with these blend contexts rather than a single context (sic., p. 35).

It is important to note that rank ordering of phonetic contexts does occur, as revealed in Schneider's work.

SYLLABIC POSITION

Syllabic position refers to the location and/or function of the phoneme within the syllable. By disregarding a sound as functioning in an initial, medial, or final position of a word, one focuses attention on the sound within the syllable (Keenan, 1961). Every syllable is comprised of three basic elements: release, vowel shaping, and arrest (Stetson, 1951). Consonants act to release or arrest vocalic sounds.

> Stetson finds that consonants may be divided into releasing consonants which start the syllable movement and arresting consonants which stop the syllable movement. The articulatory movement involved in producing the same consonant in a releasing or an arresting position appear on superficial examination to be the same. Their role in the syllable, however, creates significant differences between them (McDonald, 1964, p. 80).

In the literature, it was seen that the words "releasing" and "initiating" are used synonomously to infer starting of syllabic movement; and "arresting", "terminating", and "finalizing" were words all referring to the stopping of the

syllabic movement.

SYLLABIC STRESS

Syllabic stress is a means of identifying accented and unaccented syllables. Fairbanks (1960) distinguishes between stress and accent: "Stress refers to relative vocal prominence, and is a combined effect of duration, pitch, and intensity...Accent...refers to the relative stress of a syllable in a word..." (p. 159). Fry (1958) and Lehiste and Peterson (1959) report that fundamental frequency, vowel quality, and duration, as well as the length of the syllable, and its intensity all assist in indentifying stress patterns. By shifting the stress from one syllable to another, semantic variations occur. It is possible to change a word from a noun form to a verb form by stressing different syllables of the same word. For example, by shifting the stress from the first syllable to the second syllable in the word "contest", the noun meaning a competitive game is changed into a verb meaning to disagree.

Fry (1958) reports that the fundamental frequency of syllables primarily determines the perception of stress. He does not discount the interraction effect of the other vari-

ables, however. The syllable with the higher fundamental frequency will be perceived as the stressed syllable, regardless of the magnitude of the pitch change. "...a stress judgment may be influenced by the length of the syllable, and particularly by the length of the vowel, but not independent of the vowel quality" (Fry, 1958, p. 128). Bolinger (1955) considers intonation to be crucial to the identification of stress. Zipf (1935) observed that the more frequently occurring elements have lesser degrees of accent. Stetson (1951) reports that intrapulmonic pressure is the major influencing factor of stress. Electromyographic studies of speech samples support this conclusion (Ladefoged, Draper and Whitteridge, 1958).

After viewing the prominent influence of syllable stress on the production of phonemes, it appears evident that syllable stress should become an automatic consideration of misarticulations. The combined influences of phonetic context, syllable position, and syllable stress provide valuable information about the error rules which a child is maintaining in his speech patterns.

Griffith and Miner (1973) suggest improvements in phonetic context deep testing by emphasizing syllabic position and stress as important variables in sound production. One

phoneme that they considered was the consonant /r/. From the Thorndike-Lorge list of the first 1000 most frequently occurring words for first and second grade children, 269 /r/ words in vowel and consonant blends appear. They chose to disregard the conventional initial, medial, final positions of phonemes in words, and relied upon Stetson's theory of sound-syllable and syllable stress identification of phonemes. With this classification, they identified the phonetic contexts of all /r/ words in the 1000 words listed. The three most frequently occurring syllabic position and stress categories were, respectively: the arresting or finalizing sound of an accented syllable (F/A), the releasing or initiating sound of an unaccented syllable (I/UA), and the releasing or initiating sound of an accented syllable (I/A). They found the most frequently occurring phonetic contexts for each category to be, respectively: /ɛr/, /rɪ/, /rɛ/. Thus, each /r/ context was classified as follows: the /ɛr/ context illustrates (F/A); the /rɪ/ context illustrates (I/UA); and the /rɛ/ context illustrates (I/A). These phonetic contexts and stress classifications are represented in the words "bear", "every", "red". Linguistic stress reveals differences in words which the traditional initial, medial, and final divisions do not

differentiate.

It is important to note Schneider's results (1973) concerning the relationship among phonetic context, syllabic position, and syllabic stress for the /r/ phoneme. These results are as listed below.

1. ...the single contexts /or/ (F/A), /ra/ (I/A), and /arr/ (F/A) were found to be most facilitating in correct production, while /ro/ (I/UA), /ri/ (I/A), and /ru/ (I/A) were found to be least facilitating (p. 57).

2. For /r/, the blend contexts /pr/ (I/UA), /dr/ (I/UA), and /str/ (I/A) were found to be most facilitating in correct production, while /rm/ (F/A), /rk/ (F/A), and /fr/ (I/A) were found to be least facilitating (p. 58).

3. Syllable stress (accented or unaccented) did not influence the number of correct productions for /r/...(p. 59).

4. Although neither position nor stress was responsible for the rank ordering of phonetic contexts in /r/ and /s/ phonemes, an interaction of these parameters was a greater determining factor of the rank order (p. 59).

5. ...rank orders of correctly produced phonetic contexts were not related to the frequency of occurrence of these contexts (p. 60).

6. ...interactions of position and stress were more important determining factors of the contexts' correct productions (p. 60).

7. Blends were produced correctly with greater frequency than singles (p. 61).

THE LANGUAGE MASTER AS AN INSTRUCTIONAL DEVICE

The available literature concerning the Language Master as an instructional device for speech and language therapy is limited. A study conducted in 1970 by Berken evaluated the effectiveness of the Bell & Howell Language Master(R) audio-visual instructional system. The study was made over a five-month period in which English was taught to second, fourth, and sixth grade American-English speaking children. The results seemed to indicate that this system "can lead to sustained improvement in the children's ability to speak English", especially fourth and sixth graders (Berken, 1970).

Torrans (1972) ran a study using the Language Master as an aid to classroom teachers for improving the speech and reading skills of school children. Language Master cards were prepared with the following information on each card: a sound, a word containing the sound, a repetition of the sound, the printed word, the letters representing the sound, and a picture of the recorded word. Results showed no significant differences in the reading abilities of the children, but did show a significant increase in articulation proficiency at the 0.05 level. Although the selected phonemes for this study were not cited, it may be inferred that in general, the Lan-

guage Master functioned effectively as an instructional device in the correction of misarticulations.

Odom and Boatman used the Language Master for "A Study of Certain Variables Affecting Language Development in Educable Mentally Retarded Children" (n.d.). They also dealt with the audio-visual instructional system of this machine using both manufactured and teacher-made cards. The purpose of the study was to supplement instruction within the classroom. The authors concluded that this method was particularly successful in stimulating and improving the language of the EMR child.

Griffith and Miner (1973) prepared a Language Master articulation therapy curriculum. This program takes into account the influence of phonetic context, syllable position, and syllable stress. Griffith and Miner state that "the skill in learning a new sound is influenced by sounds that precede and follow any given sound--phonetic context" (1973, p. 9). Following the program outline, a clinician is able to identify the phonetic contexts which are in error in a child's speech, and manipulate appropriate speech sound sequences for therapy materials. This has been termed a "skill-building sequence" by the authors. Again, the Language Master has been reported

to be an effective instructional device for speech and/or language therapy.

BEHAVIOR MODIFICATION

Modification of defective articulation has been accomplished through shaping techniques. Shaping "involves the use of differential reinforcement and successive approximation to develop new behavior" (Sloane and MacAulay, 1968, p. 10). Reinforcement of correct responses or successive approximations toward a correct response is necessary for learning to occur. "In order that behavior be learned, it is necessary for it to be emitted and reinforced" (Sloane and MacAulay, 1968, p. 260). In articulation therapy, one must produce the phoneme or attempt to produce it before it can be judged and modified. As one's production approximates that of the model, he is reinforced. By "providing differential reinforcement only for these response variants in the existing repertoire that more closely approximate the desired terminal behavior" (Sloane and MacAulay, 1968, p. 10), the child

> produces new response variations that were not previously emitted. The teacher may then change the criteria for acceptable responses that match the desired production even more closely, and thus again shift the distribution of responses

emitted (Sloane and MacAulay, 1968, p. 10).

Reinforcement is to be considered any occurring event which immediately follows an act of behavior and which increases the probability of that behavior reappearing. It is vital that the reinforcement be clearly obvious and punctual. If the reward or reinforcement is delayed, intervening behaviors may be encouraged (Travis, 1971, p. 235). This type of therapy schedule for developing new articulatory responses for /s/ and /r/ productions was used successfully by Griffith (1965) in a study with twenty-five articulatory defective children.

In discussing behavior modification, based upon instrumental conditioning and of which shaping is a basic function, Miner (1973) makes the point that:

> our field has accumulated approximately 15 years of research empirically demonstrating that it is a viable approach in modifying articulatory behavior...Yet, as we survey the field, this approach is just now finally beginning to catch on at the grass roots level (p. 29).

Miner proposes six reasons accounting for the reluctance or refusal to practice behavior modification techniques.

1. Few clinicians have been adequately trained in learning theory; therefore, the principle and terms are unfamiliar and over-whelming.

2. Too many authors get lost in the complexity of the topic. The result is that the fundamental principle is masked and unrecognized by the inquiring clinician.

3. The idea of learning approaches has been offered to educators as a cure-all technique. Having not met all expectations, the theory or practice acquired negative overtones.

4. It is suggested that instrumental conditioning is too impersonal.

5. Clinicians comment that their feelings of having helped a child are stifled.

6. The single most crucial factor is that use of operant conditioning and shaping procedures are not routinely taught to students within the speech pathology curriculum (Miner, 1973, pp. 29-30).

These six factors aside, there is reason to believe that behavior modification using the principle of operant conditioning and shaping techniques is becoming a more widely taught and practiced therapeutic approach.

TABLE 2.--Rank Ordering of Percentages of Correct Productions for /r/ Single and Blend Contexts *

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

* As reported by Schneider (1973).
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TABLE 3.--Rank Ordering of /r/ Contexts in Singles and Blends According to Percentages of Correct Productions Within Each Stress Category *

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

* As reported by Schneider (1973).
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TABLE 4.--Rank Ordering of the Frequency of Occurrence for /r/Contexts in Singles and Blends as a Function of Syllable Stress *

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

* As reported by Griffith and Miner (1973).

TABLE 5.--Rank Ordering of /r/ Contexts in Singles and Blends as a Function of Syllabic Stress According to Total Subjects Percentages of Correct Productions *

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

* As reported by Schneider (1973).
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CHAPTER III

PROCEDURE

SUBJECT SELECTION

Twenty-one children were screened for participation in this study. Fifteen children met the standards for selection. They were selected from the caseload of one speech clinician in the Mattoon, Illinois public school district. Subject selection was on the basis of five variables: age, intelligence, hearing, articulation, and amount of therapy.

1. Age: As the phoneme /r/ may not appear in some children until the age of 7.5 years (Poole, 1934), all subjects were required to be at least eight years of age. The selected subjects ranged in age from eight years-four months to fourteen years-three months.

TABLE 6.--Age Range of Subjects

Subject	Age	Subject	Age	Subject	Age
1	9-1	6	13-3	11	8-6
2	8-10	7	10-7	12	8-5
3	9-0	8	12-1	13	8-4
4	14-3	9	11-4	14	8-6
5	13-7	10	12-9	15	11-6

2. Intelligence: Students enrolled in an EMR class were not considered for participation in this study.

3. Hearing: All subjects passed a bilateral sweep test of 15 dB at the frequencies of 250, 500, 1000, 2000, and 4000 Hz. The children were tested in their regular speech room so that screening and therapy conditions throughout the study were as alike as possible for each child.

4. Articulation: Those children who met the above criteria of age, intelligence, and hearing acuity, and who were identified by the school speech clinician as having a functional substitution or distortion of the /r/ phoneme were given a twenty-item screening test of articulation. Six of the words were designed to test /r/ productions in the three most frequently occurring /r/ contexts: /ɛr/, /rɪ/, /rɛ/. There were two words for each of the three contexts. The other fourteen test words were included as foil items. A child was selected for participation in the study if he exhibited an /r/ substitution or distortion on one of the two words for each of the three phonetic /r/ contexts. His performance on the fourteen foil items was not taken into consideration.

5. Therapy: Each subject had received at least six months of therapy for correction of deviant /r/ productions

prior to this study, and was maintaining production errors. Further therapy was indicated for each child.

SCREENING SITUATION

Twenty-one children who met the above five criteria were given a twenty-item screening test of articulation. Of the twenty words on the screening test, six words contained the /r/ phoneme in the appropriate phonetic contexts for syllable position and syllable stress. There were two words for each of the three most frequently occurring phonetic /r/ contexts. They were "air" and "bear" for /ɛr/ (F/A); "every" and "berry" for /rɪ/ (I/UA); and "red" and "rent" for /rɛ/ (I/A). These six words were arbitrarily chosen from word lists for each of the three most frequently occurring phonetic /r/ contexts (Griffith and Miner, 1973). If the subject misarticulated one /r/ word for each of the three contexts, he was eligible for participation in this study. Articulatory proficiency on the other fourteen words was not taken into consideration for subject selection. These fourteen words were included in the screening test as foil items. They were randomly chosen from the Dale and Chall list of words that can be read by first and second graders (Dale and Chall, 1948).

Each of the twenty words on the screening test of articulation was typed on a 3x5 card. Each child was asked to read the word aloud as the examiner presented it. The words were presented in the same order for each child. The word order was determined from a table of random numbers (Downie and Heath, 1970, pp. 328-329).

TABLE 7.--Screening Test of Articulation

1.	every*	11.	feel
2.	to	12.	berry*
3.	if	13.	bear*
4.	on	14.	pop
5.	so	15.	dig
6.	door	16.	call
7.	is	17.	pin
8.	red*	18.	run
9.	men	19.	rent*
10.	air*	20.	talk

* Words for the three phonetic contexts under investigation.

The screening of all subjects was completed in two days. It took approximately five minutes to screen the hearing and speech of each subject. Some children were screened for the study during their regularly scheduled therapy session. It should be noted that those children who came for screening before attending therapy may not have had the same speech set as the children who came for screening after attending

their therapy session. This assumption was not verified, however.

EXAMINER RELIABILITY

Prior to the study, a pilot study was conducted for the purpose of establishing intra- and inter-examiner reliability on the consistency of examiner judgment on subject responses.

A therapy session designed like that of the actual study was conducted with an eight year old child from the Buzzard Laboratory School on the Eastern Illinois University campus. The child satisfied all of the criteria for participation. The entire session was video-taped for replay at a later date. Throughout the session, the examiner reinforced and recorded all responses made by the subject.

One week later, the tape was viewed by the examiner and two professors from the department of speech pathology and audiology at Eastern Illinois University. As the tape was played, the three viewers tallied the number of subject's responses which they felt deserved reinforcement through a shaping approach for therapy. The viewers indicated the total number of reinforced responses for each of the three test words. They did not indicate which of the responses in the

tally were selected for reinforcement.

For intra-examiner reliability, a per cent agreement index was computed between the examiner's judgment of reinforced responses of the initial therapy session and her analysis a week later. The intra-examiner per cent agreement index was 87 per cent. This index was interpreted to suggest a high level of intra-examiner reliability.

For inter-examiner reliability, an intraclass correlation for averages was computed among the judgments of the two professors and the second analysis by the examiner. The resulting intraclass (average) correlation was $r = .90$. This coefficient was interpreted to suggest a high level of inter-examiner reliability.

ITEM SELECTION

Griffith and Miner (1973) identified all /r/ words which are present in the Thorndike-Lorge list of 1000 most frequently occurring words for first and second graders. After classifying the 269 /r/ words on the basis of syllable position and syllable stress, they identified the occurring phonetic /r/ contexts. The three most frequently occurring phonetic /r/ contexts for syllable position and syllable stress were

/ɛr/ (F/A), /rɪ/ (I/UA), and /rɛ/ (I/A). These three contexts were selected for investigation in the present study. To represent each context, the following words were arbirarily chosen from the phonetic context lists for /r/: "bear", "every", "red", respectively.

TABLE 8.--Syllable Position, Syllable Stress, and Word Examples of the Three Most Frequently Occurring Phonetic /r/ Contexts

Phonetic /r/ Context	Syllable Position / Syllable Stress	Word
/ɛr/	(F/A)	"bear"
/rɪ/	(I/UA)	"every"
/rɛ/	(I/A)	"red"

So that the order in which the three words were to be presented to each subject during each session would not affect the data, the order of presentation was randomized (Downie and Heath, 1970, pp. 328-329). By assigning one number to each phonetic context and consulting a table of random numbers, forty-five word orders were determined for presentation throughout the study. The context /ɛr/ was assigned the number one, the context /rɪ/ was assigned the number two, and the context /rɛ/ was assigned the number three. The distribution of words over all three therapy sessions for all fifteen subjects is provided in Table 9.

TABLE 9.--Randomized Order for Word Presentation

Subject	Session I	Session II	Session III
1	red, every, bear	bear, red, every	every, bear, red
2	bear, red, every	red, every, bear	bear, red, every
3	red, every, bear	red, every, bear	bear, red, every
4	red, every, bear	red, every, bear	every, red, bear
5	every, bear, red	red, every, bear	every, red, bear
6	red, bear, every	bear, every, red	bear, red, every
7	every, bear, red	bear, red, every	red, every, bear
8	red, bear, every	every, bear, red	bear, every, red
9	red, every, bear	every, bear, red	red, every, bear
10	every, red, bear	red, every, bear	bear, every, red
11	bear, red, every	red, every, bear	red, every, bear
12	red, bear, every	red, bear, every	red, every, bear
13	red, bear, every	bear, every, red	every, bear, red
14	every, bear, red	every, bear, red	bear, red, every
15	bear, every, red	bear, red, every	red, bear, every

THERAPY SITUATION

Screening of subjects and all therapy sessions were completed within four weeks. All screening was accomplished during the first week. Each of the fifteen subjects was seen for three therapy seesions. Each subject met with the examiner once a week for three consecutive weeks. The sessions were approximately twenty minutes in length. During each session, the subject received articulation therapy for the /r/. The Language Master(M717) was used as the instructional device. Three blank Language Master cards were prepared for the words "bear", "every", and "red". Each word was recorded three

times on a separate card.

The word order varied among the children and among the sessions. Each word was presented three times per card. The presentation time of each card is 3.3 seconds, allowing each word to appear at approximately one second intervals. The card was played four times so that the subject heard the stimulus word twelve times. The voice on the cards was that of a female graduate student in the department of speech pathology and audiology at Eastern Illinois University.

Following the stimulus presentation, the subject responded by saying the word fifteen times consecutively. Those responses which the examiner judged as either correct or approximations to a correct response were reinforced. The sequence of listening to the twelve stimulus presentations and responding fifteen times constituted one word set. There were five word sets per word, totaling seventy-five attempted responses for each word per session.

One of two criteria were met before continuing onto the next word: a word set limit or a time limit. The subject either completed five word sets on the specified word, or he spent six minutes of time on the word. A similar criterion level determined the length of each therapy session. The sub-

ject either completed five word sets for each of the three words, or he spent a total of eighteen minutes on the three words. In no case was the time limit the determining factor. In all instances, the production criterion was met. The longest therapy session lasted fifteen minutes.

Reinforcement of a child's responses was indicated by the presentation of a light following the behavior modification principle of shaping. The light was connected to two digital counters. Every time the examiner reinforced a response, he contacted the control switch, the light appeared, and a tally of the response was recorded. Before the next word set began on a given word, the examiner recorded the number of reinforcements per trial of fifteen responses on a graph for that given word. This was done for all three words and was compiled over the three therapy sessions for each subject.

At the conclusion of each session, the total number of reinforcements for all three words from that session was tallied and written down on a "point card" for the child. This succeeded in motivating the child to raise his score and thereby forced him to attempt more correct productions. The competition for the highest number of points, and indirectly the

most improved articulation, within each subject and among the subjects as a whole was unexpected but a definite asset to the therapy session.

RECORDING OF RESPONSES

The performance of each child on the screening articulation test was recorded on a running log for all children tested. Responses were recorded as correct (✓), distorted (x), substituted (phonetic symbol for the substituted sound), and omitted (--). Only those children with /r/ substitutions or distortions in one of the two words for each of the three /r/ contexts were eligible for participation in the present study. Only the subjects' productions on the six words for the three /r/ contexts were recorded. It was found that the phonemes /w/ and /ʊ/ were the only substitutions for /r/ made by the fifteen selected students. A combination of substitutions and distortions throughout the six test words was exhibited by the subjects.

During the therapy sessions, judgments of articulatory competency were evaluated as correct, approximate, or incorrect. All correct and approximate responses were treated as reinforced responses, and were not recorded differentially.

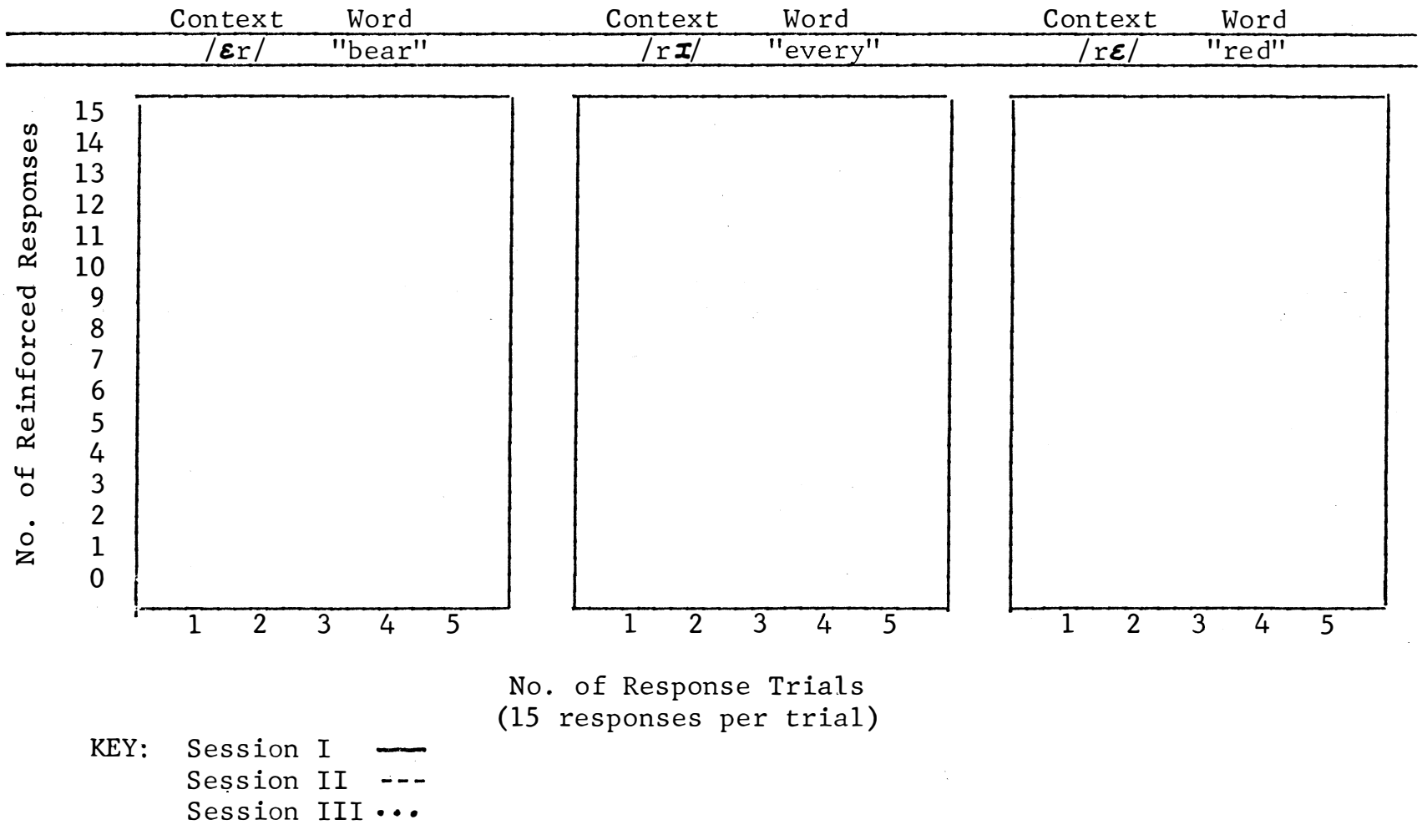
The examiner controlled a digital counter which was wired to a light. Each time a correct or approximate response was made, the examiner contacted a switch which both tallied the response and rewarded the response with the presentation of a light. At the end of each trial of fifteen responses, the tally of reinforced responses was entered on a graph.

A learning curve was drawn to illustrate the number of reinforced responses each child made during each set of fifteen responses per word. The performance of each weekly session was recorded on the appropriate word graph so that performance within each phonetic /r/ context was observable over time. A copy of the graph is provided in Graph 1.

ANALYSIS OF DATA

For the subjects' performance on each of the three contexts during the three sessions, the ratio of the number of reinforced responses to the number of trial responses will be converted to a decimal proportion value. A Kruskal-Wallis H Test of Significant Difference will be computed on those decimal values to determine the existing differences among the three contexts. A total of forty-five scores for all contexts will be used to compute the one-way analysis of vari-

GRAPH 1.--Graph for Recording of Reinforced Responses



ance. Those scores will be derived by first converting the ratio of reinforced responses to trial responses (#Rr/#R) to a proportionate decimal value for each context per subject over all three sessions. The proportion values from all three sessions for each context will be added together to provide a cumulative score for that context. This will be done for all fifteen subjects, yielding three context scores for each subject (Downie and Heath, 1970, p. 275).

If differences are found to exist among the three contexts, the Mann-Whitney U Test of Significant Difference will be computed to determine the magnitude of the difference between the contexts /ɛr/ and /rɪ/, /rɪ/ and /rɛ/, and /ɛr/ and /rɛ/.

CHAPTER IV

RESULTS AND DISCUSSION

Fifteen children were given articulation therapy for correction of /r/ substitutions or distortions as they appeared in three /r/ contexts: /ɛr/, /rɪ/, /rɛ/. Reinforced responses were graphically recorded for each context. Response ratios were calculated for each subject's performance on each context. The response ratios were converted into decimal proportions. Statistical analysis was applied to the decimal values.

PHONETIC CONTEXT DIFFERENCE

In order to assess the significance of the difference among the three /r/ contexts, the Kruskal-Wallis H Test of Significant Difference was applied. The criterion measure for analysis was determined by the response ratio (RR) of the number of reinforced responses (Rr) to the total number of responses (R). The response ratio was written as #Rr/#R. The resulting H value was 4.07. This value failed to reach the .05 level of confidence. The null hypothesis was, therefore, accepted.

The results were interpreted to mean that there was no statistically significant difference among the response ratios for the three contexts of /r/ within the conditions described in this study. These three contexts varied in both syllable position and syllable stress. The acquisition rate for each was comparable.

An ever-present therapy decision is the selection of the context with which to initiate therapy. Does it make a difference which context receives initial emphasis in therapy? The data from this study would suggest that if stimulability testing on these three /r/ contexts revealed no difference among them for ease of acquisition, then therapy could begin on any of the three contexts.

PHONETIC CONTEXT RANK ORDER

In order to determine the rank order of ease or difficulty of acquisition, the sum of the ranks for each phonetic context was calculated. On this basis, the three contexts rank order themselves in the following manner: /ɛr/, /rɪ/, /rɛ/. It should be pointed out, however, that since the H value was nonsignificant, there were no significant differences in the acquisition rate for these three contexts. The differ-

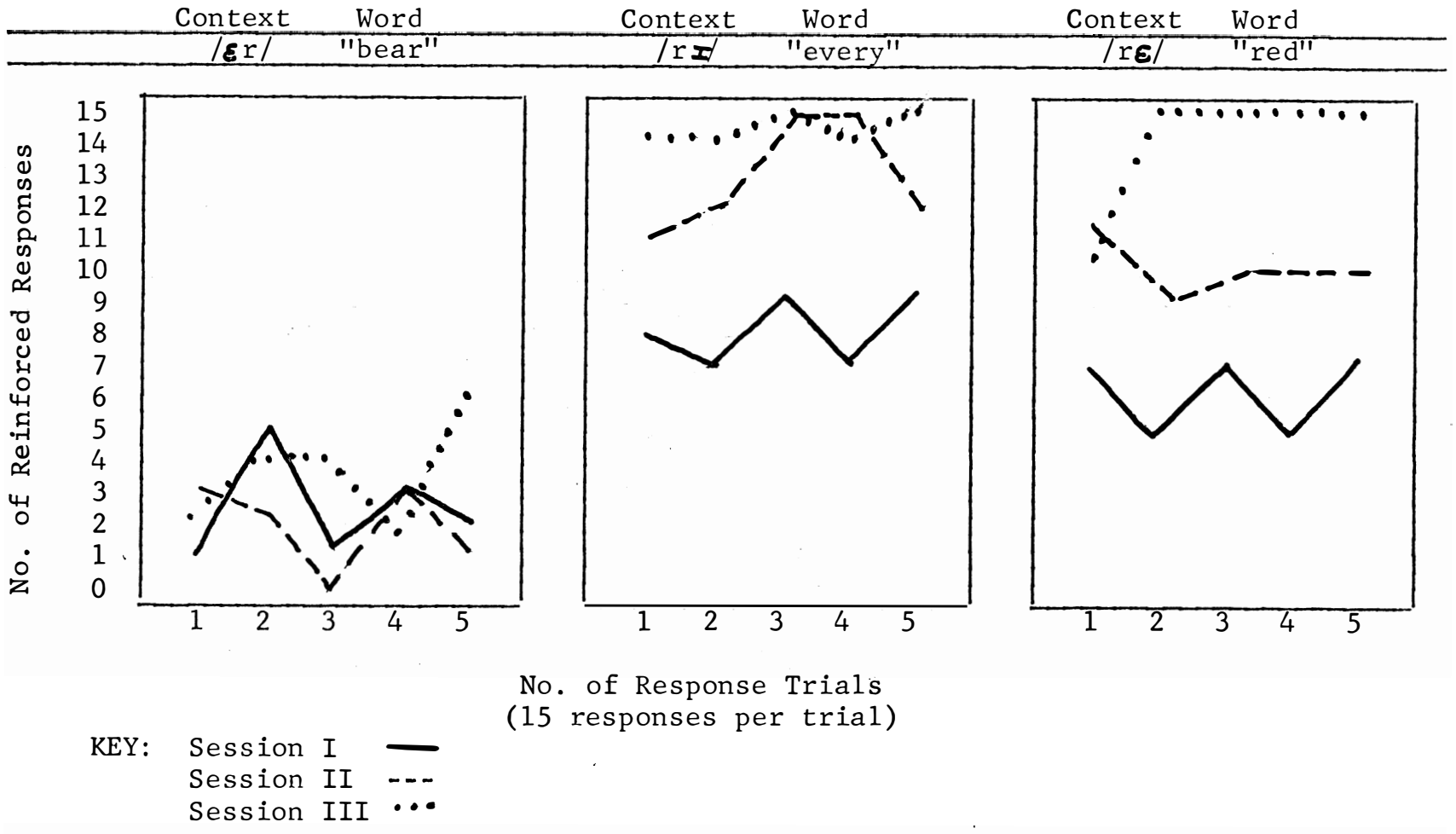
ences were not meaningful differences either statistically or clinically.

Schneider (1973) identified the three least frequently misarticulated contexts as /or/, /rɑ/, /aɪr/. The present study dealt with the three /r/ contexts which occur most frequently in the language. Combining Schneider's results with phoneme frequency of occurrence, it may be implied that therapy should begin with those context which most facilitate correct productions and then incorporate those that occur in the language with the greatest frequency. It is assumed that a transfer of learning effect would take place from those /r/ contexts which are least often misarticulated to those /r/ contexts which occur most often.

ANALYSIS OF LEARNING CURVES

Graphs 2,3,4, and 5 are samples of the performance made by four subjects throughout the study. The learning curves illustrated on Graph 2 are that of a female (CA=9-0). For the context /ɛr/, the curves indicate that the girl was learning or developing approximations to acceptable productions. For the context /rɪ/, it appears that by session three she had acquired the necessary articulatory skills since she was rein-

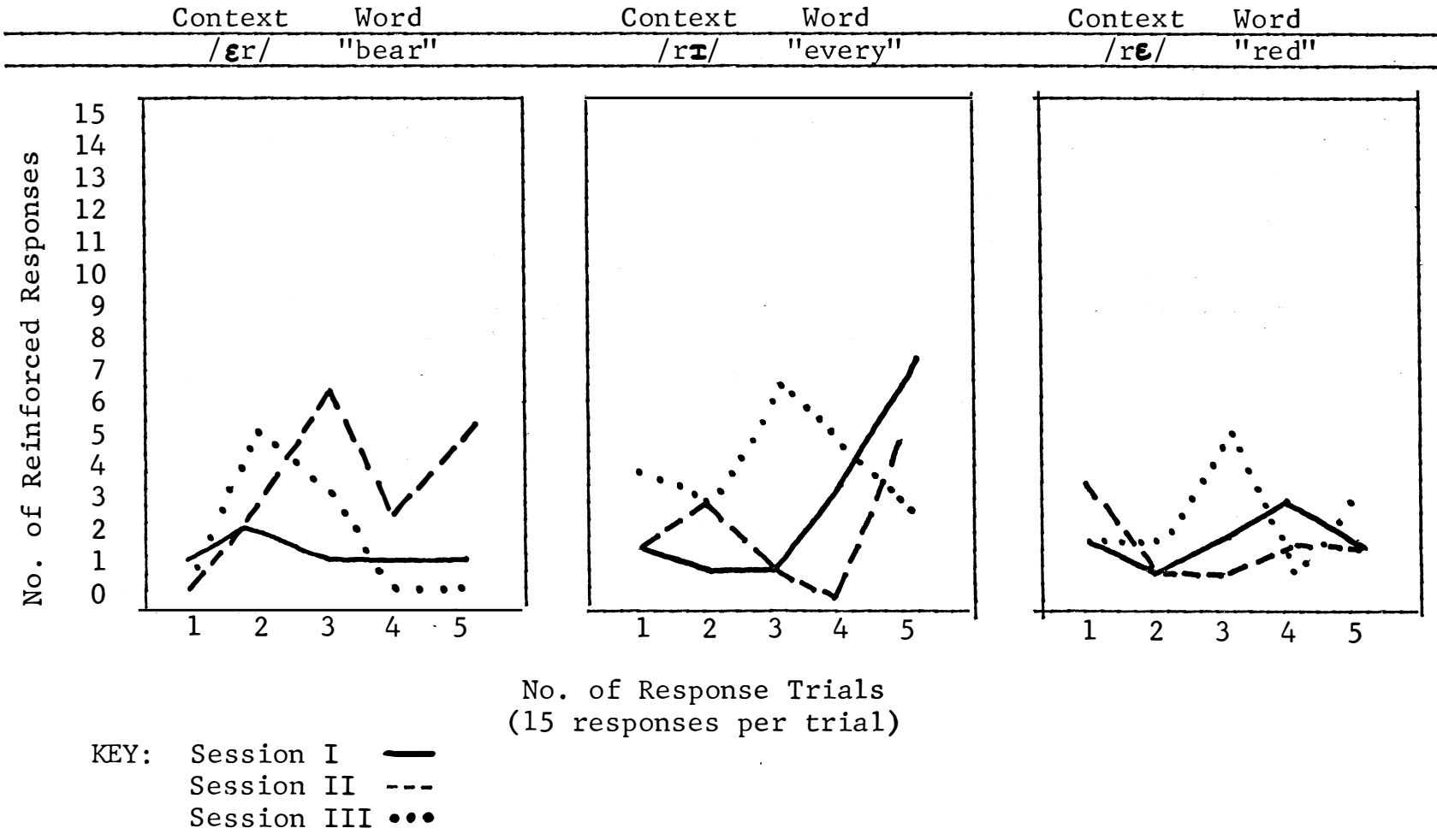
GRAPH 2.--Learning Curves of a Female (CA = 9-0)



forced over half of the time for her responses. For the context /rɛ/, progress throughout the three sessions was similar to that for the context /rɪ/. In session one for /rɛ/, she could not maintain her highest level of reinforcement. Her performance during session two exceeded that of session one, but was greatly surpassed in session three where she produced the /rɛ/ context with 100 per cent accuracy for four consecutive word sets. It had been noted that consistently throughout session three with all contexts, this child was deliberately altering the posture of her upper lip: thining, tensing, and retracting it. These labial adjustments apparently assisted her acquisition of the /r/ contexts. The change is revealed in the learning curves.

In Graph 3, a female (CA=8-6) provides a contrast to the one mentioned above. For all three contexts throughout all three sessions, her performance followed a similar pattern. Her productions seemed to be correct or incorrect by chance alone. She appeared to be unable to vary her tongue placement. She was unable to maintain appropriate phonetic features from one word set to another. In contrast to the other fourteen subjects, this child was not influenced by the shaping technique even though she expressed an interest in the graphs.

GRAPH 3.--Learning Curves of a Female (CA = 8-6)



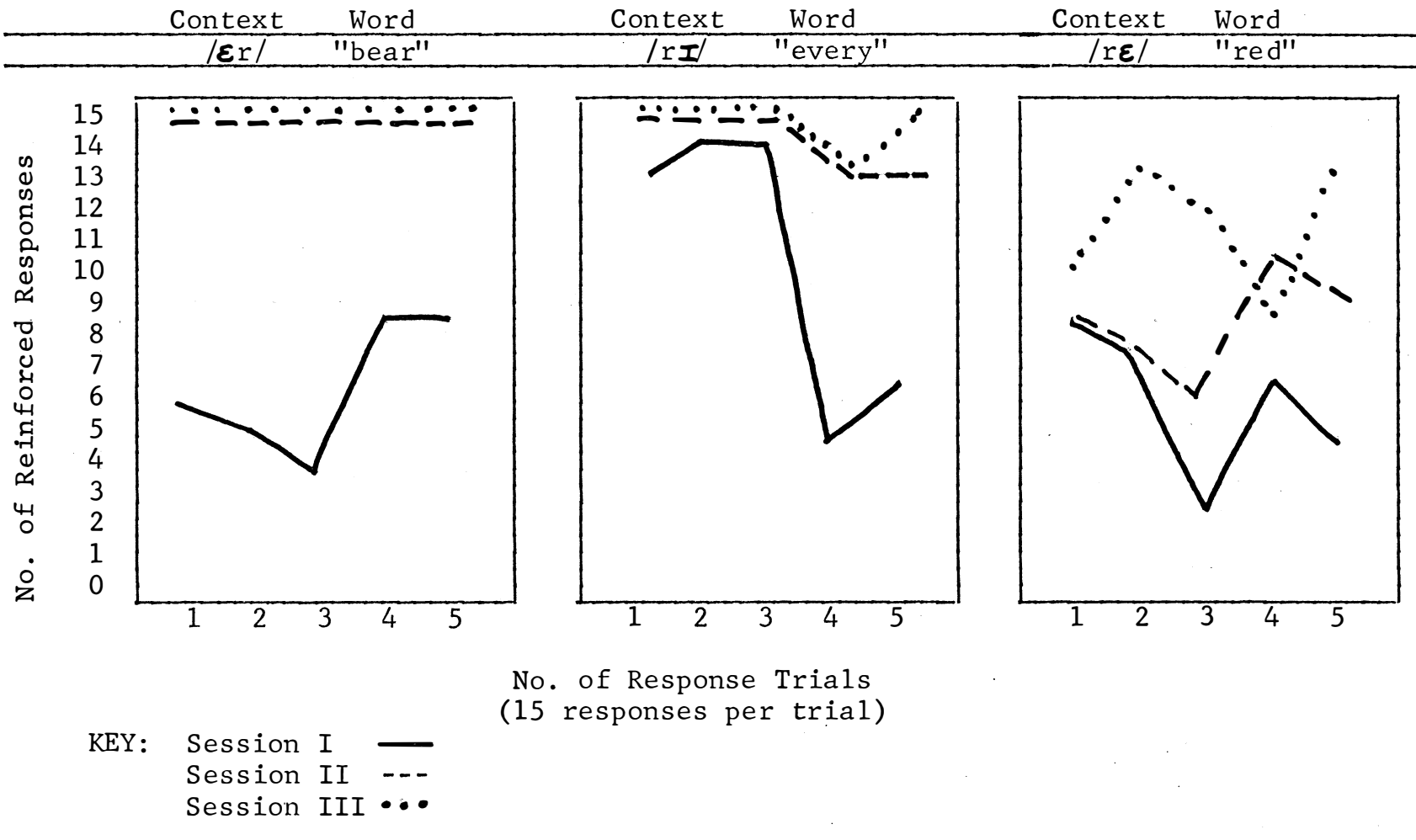
After conversing with this child, the experimenter found that a lack of motivation was a contributing factor in her performance. It is felt that this is indicated in all three sets of learning curves for this child.

The learning curves of Graph 4 are those of a male (CA=14-3). This student made rapid progress over all three sessions. The amount of progress made from session one to session two on the contexts /ɛr/ and /rɪ/ is to be noted. It appears that learning is still taking place since the number of reinforced responses for /rɪ/ and /rɛ/ do not remain constant near the end of the second and third therapy sessions.

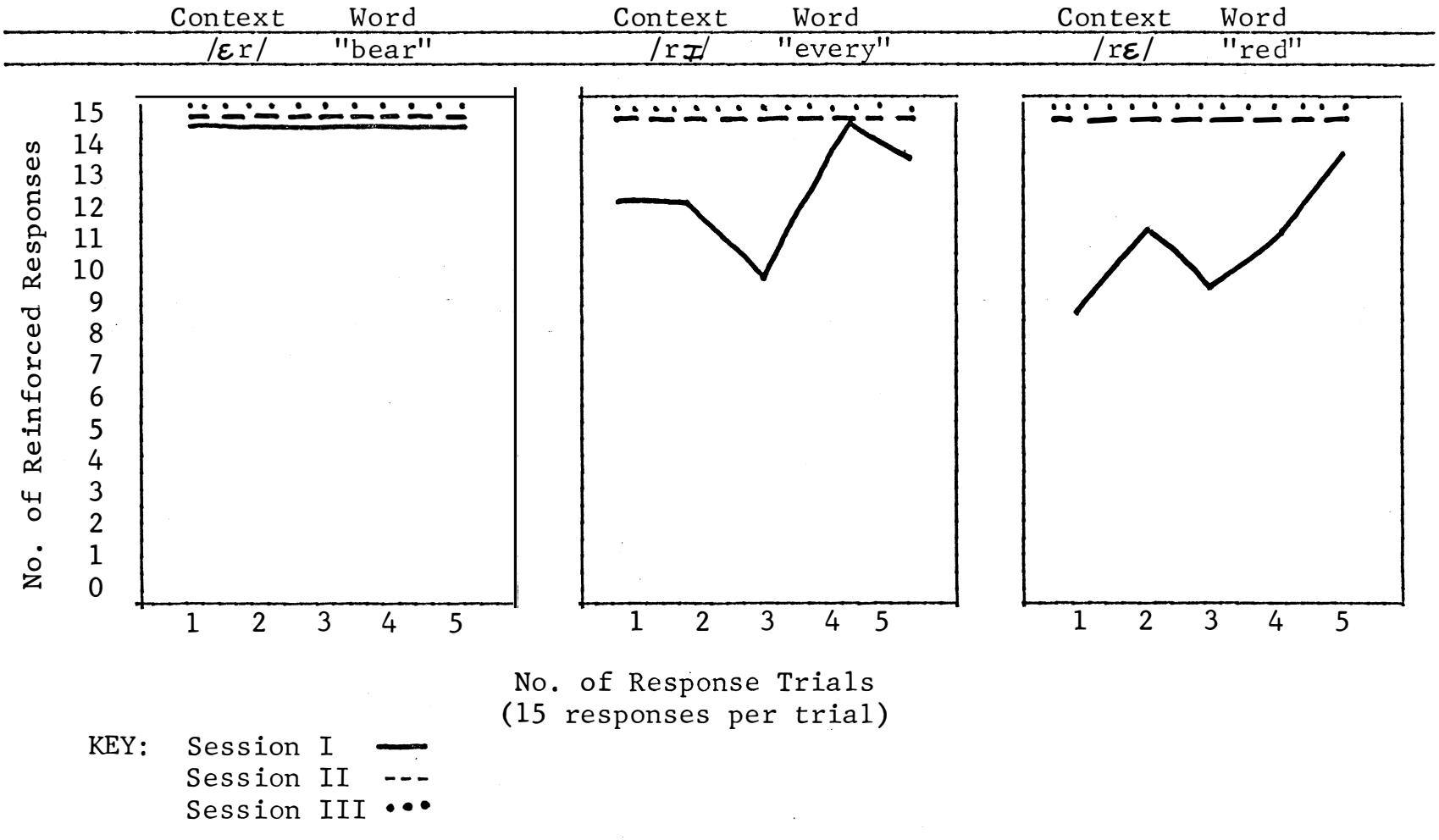
The performance on Graph 5 is that of a male (CA=8-6). This child was stabilizing his correct /r/ productions at the time he was screened for the study. However, he failed the screening test of articulation. The learning curves of this subject would indicate readiness for therapy on other phonetic contexts on the basis that he had succeeded in maintaining correct /r/ productions for all three contexts over a two session period.

Although the effect of therapy on the three most frequently occurring phonetic /r/ contexts was the concern of this investigation, the therapy technique itself deserves

GRAPH 4.--Learning Curves of a Male (CA =14-3)



GRAPH 5.--Learning Curves of a Male (CA = 8-6)



mention.

In any therapy session, productive use of the allotted time is important. With the technique utilized in this study, the examiner found it possible for a child to make 225 productions of a word or context within fifteen minutes. Depending upon the child's rate of response, it was possible, in some cases, for a subject to make 225 productions in twelve minutes. Based on the mean time of fifteen minutes, as found by this investigation, a child is able to produce an average of fifteen responses per minute. Therapy time with 225 responses per subject per session would seem to be a therapy session put to efficient use.

The method of graphing a student's performance during therapy is a meaningful account of his progress on an articulatory task. Visual illustration of verbal performance gives the child and clinician a concrete idea of his success or lack of success, as the case may be. Graphing in this study proved to be a motivational device for the subjects. The subjects were eager to produce higher curves and kept close account of their progress by referring to their graphs often. For the clinician, graphing was a quick, reliable record of a subject's total reinforced responses per response trial.

CHAPTER V

SUMMARY AND CONCLUSIONS

It was the purpose of this study to describe the articulatory responses of fifteen children with inadequate /r/ productions in three phonetic /r/ contexts: /ɛr/, /rɪ/, /rɛ/. The children were exposed to training in the production of these contexts as they appeared in the words "bear", "every", and "red".

This study was designed to answer the following questions:

1. Is there a statistically significant difference in the response ratio (RR) of the subjects to the three most frequently occurring phonetic /r/ contexts?
2. With regard to ease or difficulty of phoneme acquisition, what is the resulting rank order of the three most frequently occurring phonetic /r/ contexts following articulation therapy?

Fifteen subjects were selected for participation in this study on the basis of five criteria. 1) Age: Each subject was at least eight years of age. 2) Intelligence: Students

enrolled in an EMR class were not eligible for participation. 3) Hearing: Each subject passed a bilateral sweep test at 15 dB at the frequencies of 500, 1000, 2000, and 4000 Hz. 4) Articulation: Each subject exhibited a functional substitution or distortion of the /r/ phoneme in each of the three phonetic contexts. 5) Therapy: Each subject had received a minimum of six months of therapy for correction of deviant /r/ productions prior to the study.

Twenty-one students were screened for participation in the study. Fifteen were selected on the basis of their performance on a screening test of articulation. The screening test consisted of fourteen foil items and six words representing the three most frequently occurring /r/ contexts. There were two words for each /r/ context. If the subject substituted or distorted the /r/ context in one word for each context, he was eligible for participation in the study.

A pilot study was conducted for the purpose of establishing intra- and inter-examiner reliability on the consistency of examiner judgment on subject responses. The intra-examiner per cent agreement index was 87 per cent. The inter-examiner coefficient was $r = .90$.

Each subject met with the examiner for a therapy session

once a week for three consecutive weeks. The sessions were approximately twenty minutes long. The subject received articulation therapy for the /r/ phoneme using the Language Master (M717) as the instructional device and the three preselected words of "bear", "every", and "red". Each word appeared on an individual Language Master card three times. Each card was repeated four times, allowing the child to hear the presentation twelve times. The child then responded by saying the word fifteen times consecutively. Those responses which the examiner judged as correct or approximations to a correct response were reinforced by the presentation of a light. The number of reinforced responses was plotted on a graph. Learning curves were accumulated for each subject's performance on all three /r/ contexts.

A Kruskal-Wallis H Test of Significant Difference was computed on the decimal values for the response ratios of each phonetic context. The value of H was not statistically significant at the .05 level of confidence. The null hypothesis was accepted.

The conclusions drawn from this investigation are:

1. There is no statistically significant difference among the three most frequently occurring /r/ contexts as determined by the response ratios for each

subject within a therapy program of operant conditioning.

2. No transfer of learning was observed for acquisition of the /r/ among the three /r/ contexts.

3. It is hypothesized that a transfer of learning would take place from the acquisition of those /r/ contexts which are least often misarticulated to those /r/ contexts which are the most frequently occurring.

4. It appears that no one of the three /r/ contexts was more or less difficult to acquire than the others.

5. It is hypothesized that each of the three /r/ contexts is acquired through articulation training at approximately equal rates.

6. Results indicate that therapy can be initiated with any of the three /r/ contexts since they do not differ significantly in rate of acquisition.

7. Because the contexts do not differ significantly, it is not possible to rank order them for ease or difficulty of acquisition.

8. It was found that 225 responses could be produced and reinforced within a fifteen minute time period following the principles of shaping and operant conditioning. This technique provides one solution to unproductive therapy time.

9. Graphing of reinforced versus total responses is a rapid, illustrative manner of visually representing verbal performance. It is easily understood and serves as an excellent progress record both for the clinician and student.

It is suggested that this study be replicated for the purpose of confirming or contradicting the conclusion that the three most frequently occurring phonetic /r/ contexts when ex-

posed to articulation training do not reveal significant differences in their acquisition. An extension of the present study would be to analyze the learning curves of children exposed to articulation training for the three most frequently occurring /r/ contexts when the presentation order of the words during therapy was not randomized. It is thought that a transfer of learning effect would take place among the contexts. Another research suggestion is to investigate the therapeutic relationship between the /r/ contexts which are least often misarticulated and those that occur most frequently in the language. It would also be of clinical utility to know the effect that the transfer of learning of final /r/ blends would have on the acquisition of the most frequently occurring /r/ contexts. These research suggestions are only four possibilities for further investigation into the field of phonetic context analysis.

BIBLIOGRAPHY

Berken, Ruth. A Study to Evaluate the Effectiveness of the Bell and Howell Language Master (R) Audio-Visual Instructional System. New York: The Center for Urban Education, March, 1970.

Bingham, Dale S.; Van Hattum, Rolland, J.; Faulk, Margaret E.; and Taussig, Eleanor. "Program Organization and Management." Journal of Speech and Hearing Disorders, Monograph Supplement 8, 1961, 33-49.

Bolinger, Dwight L. "Intersections of Stress and Intonation." Word, (1955), 195-203.

Curtis, James F., and Hardy, James C. "A Phonetic Study of Misarticulation of /r/." Journal of Speech and Hearing Research, 2 (1959), 244-257.

Dale, Edgar, and Chall Jeanne S. "A Formula for Predicting Readability." Educational Research Bulletin, xxvii (1948), 11-20 and 37-54.

Downie, N.M., and Heath, R.W. Basic Statistical Methods. 3rd. ed. New York: Harper and Row Pub., 1960.

Fairbanks, Grant. Voice and Articulation Drillbook. 2nd. ed. New York: Harper and Row Pub., 1960.

Fry, D.B. "Duration and Intensity as Physical Correlates of Linguistic Stress." Readings in Acoustic Phonetics. Edited by Ilse Lehiste. Massachusetts: MIT Press, 1967.

Fry, D.B. "Experiments in the Perception of Stress." Language and Speech, 1 (1958), 126-152.

Griffith, Jerry. "The Modification of Functional Articulation Errors Under Principles of Instrumental Conditioning." Speech Monographs, 33 (2), (1965), 178-184.

Griffith, Jerry, and Miner, L.E. Reference Word Lists: Grade Levels One and Two. Chicago: Bell and Howell Co., 1973.

Griffith, Jerry, and Miner, L.E. The Language Master Articulation Therapy Program: Building Basic Articulation Skills. Chicago: Bell and Howell, 1973.

Hall, William F. "A Study of the Articulatory Skills of Children From Three to Six Years of Age." A Dissertation Presented to the Faculty of the Graduate School, The University of Missouri, (August, 1962), Copyright, 1963.

Healey, William C. "A Study of the Articulatory Skills of Children From Six to Nine Years of Age." A Dissertation Presented to the Faculty of the Graduate School, The University of Missouri, (August, 1963), Copyright, 1964.

Keenan, Joseph S. "What is Medial Position?" Journal of Speech and Hearing Disorders, 26 (1961), 171-174.

Lehiste, Ilse, and Peterson, Gordon E. "Vowel Amplitude and Phonemic Stress in American English." Readings in Acoustic Phonetics. Edited by Ilse Lehiste. Massachusetts: MIT Press, 1967, 183-190.

Leonard, Laurence B. "The Nature of Deviant Articulation." Journal of Speech and Hearing Disorders, 38 (2), (1973), 156-161.

Leonard, Laurence B., and Ritterman, Stuart I. "Articulation of /s/ as a Function of Cluster and Word Frequency of Occurrence." Journal of Speech and Hearing Research, 14 (3), (1971), 476-485.

McDonald, Eugene T. Articulation Testing and Treatment: A Sensory-Motor Approach. Pittsburgh: Stanwix House, Inc., 1964.

Miner, L.E. "Issues and Answers." Illinois Speech and Hearing Journal, 7 (1), (1973), 29-30.

Odom, Mildred, and Boatman, Rex. "A Study of Certain Variables

Affecting Language Development in Educable Mentally Retarded Children." Manhattan, Kansas: unpublished manuscript, n.d.

Pendergast, K.; Soder, A.; Barker, J.; Dickey, S.; Gow, J.; and Selmar, J. "An Articulation Study of 15,255 Seattle First Grade Children With and Without Kindergarten." Exceptional Child, 32 (1966), 541-547.

Peterson, Harold, in Buros, Oscar, Mental Measurements Yearbook. New Jersey: The Gryphon Press, 2, 1972, 952.

Poole, Irene. "Genetic Development of Articulation of Consonant Sounds in Speech." Elementary English Review, 11 (6), (1934), 159-161.

Roe, V., and Milisen, R. "The Effect of Maturation Upon Defective Articulation in Elementary Grades." Journal of Speech Disorders, 7 (1942), 37-50.

Sander, Eric K. "When are Speech Sounds Learned?" Journal of Speech and Hearing Disorders, 37 (1), (1972), 55-63.

Saylor, Helen K. "The Effects of Maturation Upon Defective Articulation in Grades Seven Through Twelve." Journal of Speech and Hearing Disorders, 14 (3), (1949), 202-207.

Schneider, Carole. Phonetic Context and Articulation Ability. Masters Thesis, Eastern Illinois University, 1973.

Sloane, Jr., Howard N., and MacAulay, Barbara D. Operant Procedures in Remedial Speech and Language Training. Boston: Houghton-Mifflin Co., 1968.

Spriestersbach, D.C., and Curtis, J.F. "Misarticulation and Discrimination of Speech Sounds." Quarterly Journal of Speech, 37 (1951), 483-491.

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

Templin, Mildred C. Certain Language Skills in Children. Minneapolis: The University of Minnesota Press, 1957.

Torrans, Anne. "The Language Master as an Aid to Speech and Reading Improvement in the Classroom." Illinois Speech and Hearing Journal, 6 (1), (1972), 12-14.

Travis, Lee Edward. "The Psychotherapeutical Process." Handbook of Speech Pathology and Audiology. Edited by Lee Edward Travis. New York: Appleton-Century-Crofts, 1971.

Van Riper, Charles. "Persistence of Baby Talk Among Children and Adults." Elementary School Journal, 38 (1938), 672-675.

Van Riper, Charles. Speech Correction: Principles and Methods. 4th. ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1963.

Williams, Frederick, ed. Analysis of Production Errors in the Phonetic Performance of School-Age Standard-English-Speaking Children. Austin: University of Texas, 1971.

Zipf, George K. The Psycho-Biology of Language: An Introduction to Dynamic Philology. Boston: Houghton Mifflin Co., 1935.