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A Contextual Analysis of Auditory Discrimination of /r/

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A CONTEXTUAL ANALYSIS OF

AUDITORY DISCRIMINATION OF /r/

(TITLE)

BY

AMY DAUGHERTY

THESIS

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I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

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DEDICATION

This thesis is dedicated to my parents and Bill Preston in appreciation of their constant encouragement and support which have never failed to be with me when I needed them most.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

It has long been assumed that auditory discrimination and articulation are related, however, the research dealing with this association has been incongruit and contradictory. Powers (1971) concludes that auditory discrimination is the most investigated parameter in determining the cause of articulation errors. On the other hand, Spriestersbach and Curtis (1951) project that those with articulation errors will consequently have poor auditory discrimination.

The fact that there is any sort of causal relationship has in itself been debated. Winitz (1969) summarizes that ten out of fourteen studies reviewed conclude that subjects with poor articulation also have poor auditory discrimination. The remaining four found no significant relationship between the two. In a review of the literature by Powers (1971), eight studies concluded that auditory discrimination and articulation are causally related, but four studies concluded that the two had no significant correlation. The lack of homogeneity in the data being analysed in these studies is probably at least a partial explanation for their conflicting results. The researchers have not yet decided which variables should be controlled or which analyses should be made. Bearing this in mind, however, it seems that the majority of the research favors some sort of association between the two, but the evidence is thus far still not conclusive.

Even those studies agreeing upon a correlation between the two have not agreed upon the manner in which the two are related. Researchers such as Travis and Rasmus (Powers, 1971), Schiefelbusch and Lindsay (1958), Farquhar (1961), and Dickson (1962) made their judgments on the premise that a person with articulation errors has an over-all defect in auditory discrimination skills. Whereas Templin (Powers, 1971), Spriesterbach and Curtis (1951), Prins (Powers, 1971), and Aungst and Frick (1964) found positive correlations between specific speech errors and an inability to discriminate the error sound. Here again final decisions have not been reached as to which parameters of discrimination and articulation should be analysed and compared, and no two of these studies examined the same variables.

While research has continued to assess the extent of dependency between perception and production, traditional approaches to articulation therapy have continued to include two major phases: 1) training in auditory discrimination, and 2) correction of the error sound. As new findings have developed in both of these phases, the methodology for their execution has been debated, elaborated upon, and revised many times over.

Methods for developing auditory discrimination have ranged from having a child cup his hands behind his ears to the use of tape loops, phonic mirrors, and language masters. Shaping techniques of articulation therapy have often incorporated training in auditory discrimination into their articulation therapy. Whereas those using the Van Riper approach to the correction of misarticulations spend a considerable amount of time with "ear training" apart from articulation therapy.

In the area of the correction of articulation errors, much of the same turn of events has taken place. The focal point for articulation therapy has been the isolated sound (Van Riper, 1972), the distinctive features of the phonemes (Winitz, 1969), the word (Backus and Beasley, 1951), and the syllable (Griffith and Miner, 1973) to mention just a few. Approaches have emphasized blends first, singles first, behavior modification, drill-work, play therapy, orosensory discrimination, and so forth.

Along with the confusion regarding auditory discrimination and articulation therapy techniques, the methods for testing each of these parameters have also been major issues. The most popular method for testing articulation errors through the years seems to have been eliciting the child's spontaneous response to picture stimuli. But other methods have intervened, and the child's imitative responses, stimulability, and use of the sound in sentences have also been tested. Deep tests have been devised to determine how often a certain articulation error recurs and in what combination of sounds. And with the development of deep tests, still more controversies arise concerning what syllabic positions should be considered.

However, in the area of auditory discrimination, debates have ensued, but changes have not been so rapid or numerous. Tests of auditory discrimination continue to test the child's ability to discriminate a stranger's production of sound. And they continue to test children with articulation errors for overall deficits in ability to discriminate. Some authors, such as Aungst and Frick (1964), feel that these inconsistencies are also found in the research dealing with auditory discrimination

and account for the discrepancies in study results. There appears, therefore, to be a need to investigate the area of auditory discrimination further to determine its necessity in therapy and the validity of present methods for measuring it. This study will examine the auditory discrimination abilities of Oriental adults with /r/ articulation errors to determine the relationship between their discrimination abilities and production errors.

STATEMENT OF PURPOSE

The purpose of this study is to determine if subjects who misarticulate the /r/ phoneme in specific contexts also have a corresponding auditory discrimination disability for those same contexts. In the event that the subjects demonstrate a difficulty with auditory discrimination, the study will determine whether or not some contexts and methods of stimulus presentation are more difficult to discriminate than others.

The study will be divided into two sets--the experimental set and the control set. The experimental set will include subjects who misarticulate the /r/ phoneme. This set will assess differences between the subjects' incorrect production of the /r/ phoneme and their ability to discriminate their errors. In order to eliminate uncontrollable variables, the control set will include the same subjects as the experimental set, however, this set will be concerned with the subjects' correct production and discrimination of the /s/ phoneme.

QUESTIONS

1. Do statistically significant differences exist among the types of stimulus presentation and among the response modes for auditory discrimination scores of the experimental set?

a. Do statistically significant differences exist among types of stimulus presentations?

b. Do statistically significant differences exist among types of response modes?

c. Is there a statistically significant interaction between stimulus presentations and response modes?

2. Do statistically significant differences exist between the types of stimulus presentations for auditory discrimination scores of the control set?

3. Do statistically significant differences exist between the auditory discrimination scores of the experimental set and the control set?

4. Do statistically significant differences exist between articulation errors and auditory discrimination scores for the /r/ contexts in the experimental set?

CHAPTER II

REVIEW OF THE LITERATURE

THE DEVELOPMENT OF AUDITORY DISCRIMINATION

Auditory discrimination is defined by Wepman as "the ability to recognize the different phonemes of spoken language even when the phonetic structures, especially the sound-wave patterns, of the sounds to be discriminated are highly similar in nature" (1960, p. 325). Wepman (1960) also states that auditory discrimination develops sequentially on three levels.

1. Acuity: The ability to collect sounds from the environment and transmit them to the nervous system.
2. Understanding: The ability of the central nervous system to extract and interpret meaning from the aural patterns transmitted to it.
3. Discrimination and retention: The ability to differentiate each sound from other sounds and to remember them long enough to moderate speech or to make accurate phonemic comparisons.

These levels begin as early in life as the first week as demonstrated by an infant's changes in cardiac and sucking rates in response to gross sounds (Wepman, 1960 and Locke, 1970). An infant learns very early to discriminate between his mother's soothing voice and that of a stranger. Research indicates (Locke, 1970) that infants begin discriminating between phonemes as early as one month of age, and by the time they are eighteen to twenty-four months old thay are often able to accurately judge phonemic variations.

Finally the child can accurately discriminate and retain each phoneme and begins to pattern his speech sounds after those around him (Wepman, 1960). Many investigators such as Templin (1957), Weiner (1967), Wepman (1960), and Winitz (1969) feel that this process is an ongoing one that improves as the child matures. There seems to be a general agreement that its development reaches a peak around seven to nine years of age.

Winitz (1969) offers two theories of discrimination learning in relationship with faulty articulation. First, he states that "speech sound discrimination is a maturational process which is often delayed" (p. 197). On the other hand, he suggests that "after some point in time (probably two years of age) speech sound discrimination scores reflect the speech sound experience (phoneme systems) of children" (p. 197). Locke (1970) also feels that one shouldn't automatically conclude that faulty perception leads to faulty articulation. He argues that research in the area "is marked more by its disagreement and inconclusiveness than by any kind of general trend" (p. 3).

AUDITORY DISCRIMINATION TESTS

The Travis and Rasmus Test (Weiner, 1967) is probably the predecessor of auditory discrimination tests. It was developed in 1931 for an early investigation of speech-sound discrimination and included 366 pairs of speech sounds for comparisons. This test and modifications of it served as a testing instrument for many of the early studies in the area of auditory discrimination. Many later tests utilized the format set forth by this original test as a guideline.

The Templin Speech Sound Discrimination Test (Weiner, 1967) was the first standardized test to be devised. The original study conducted in 1943 contained seventy pairs of nonsense syllables and followed the same general procedure used in the Travis and Rasmus Test. In 1957, the test was revised to include fifty of the most discriminating items as determined by the 1943 study.

Hall (Weiner, 1967) developed an auditory discrimination test in 1938 which used an approach different than the paired item task. Her test used coined words in meaningful sentences. The subject was directed to identify the incorrect word. Mase (Weiner, 1967) in 1946 used Hall's general format in generating a new test. However, instead of using nonsense words, he used words similar in sound to the correct word.

Next picture auditory discrimination tests began to develop, and the subject was required to respond to both visual and auditory stimuli. Usually the client was asked which picture was named by the tester or if the words represented by the pictures sounded alike or different. The Pronovost and Dumbleton (Powers, 1971) picture test was developed in 1953 for young children. For each item, three pairs of pictures were presented involving only two different words. Two of the pairs matched to two of the pictures were alike, but the third pair matched to the third picture included one of each of the other word pairs so that the pair was unmatched. The child was required to point to the picture he thought the examiner had named.

Anderson (Spriestersbach and Curtis, 1951) and Farquhar (1961) were the first to individualize auditory discrimination testing and develop test procedures incorporating the subjects own misarticulations.

The Wepman Auditory Discrimination Test (Wepman, 1960) developed in 1958, follows much the same general procedure as the earlier tests, and is widely used today. The subject listens to forty pairs of words read to him by the examiner and indicates whether they are the same or different. The pairs are matched for frequency with the phonemes in the same position in pairs (e.g., cap and cat).

The most recent test of auditory discrimination was developed by Goldman, Fristoe, and Woodcock (1970). This test adds a new dimension to speech sound discrimination testing. Using the premise that people don't ordinarily discriminate in perfectly quiet situations, the authors have devised two subtests--one administered without background noise and one with background noise. This test presents sixty-one words combined in various sets of four. The client then points to the picture in each group which a recording designates.

In summary, the following is a list of the major components contained in the main tests of auditory discrimination being used at the present time.

1. paired comparison tests using syllables and words
2. tests utilizing pictures
3. generalized tests which test even those phonemes not misarticulated
4. tests in which the subject listens to the examiner produce the stimuli
5. tests in which the stimuli are pre-recorded
6. tests utilizing background noise

As is revealed in this list, the method of testing for deficits in auditory discrimination is by no means stabilized. Extensive research has been done to determine which method of testing yields the most valid results, but it for the most part has also been contradictory.

RESEARCH IN AUDITORY DISCRIMINATION

As mentioned earlier, auditory discrimination and its relationship to sound production is still a controversial issue. A review of the literature concerning sound discrimination and sound production reveals a discrepancy between these two. Although Winitz (1969) and Powers (1971) cite several studies which conclude that poor discrimination leads to poor articulation, they also cite several others that demonstrates no direct cause and effect relationship between the two.

The first study comparing the overall auditory discrimination abilities and articulation skills of normal speaking and misarticulating subjects was conducted by Travis and Rasmus (Powers, 1971). The discrimination test they originated for this study was the Travis and Rasmus Test reviewed earlier. The test was administered to three paired groups of defective and normal speaking subjects from junior primary through fifth grade. At all levels, those with articulation errors had lower scores on the discrimination test than the control group. Using the same auditory discrimination test, Hall (Powers, 1971) conducted a study in 1939 with elementary school children and college freshmen paired in groups with and without articulation defects. No significant differences were found between the good and poor speakers in auditory discrimination abilities.

In 1937 Carrell (Powers, 1971) used a modified version of the Travis and Rasmus Test and found that those with articulation errors scored somewhat lower than those without errors, but the difference wasn't as great as the original Travis and Rasmus study. Barnes (Powers, 1971) used the same modified version but found no significant differences between two groups with and without articulation errors.

Hall (Winitz, 1969) in 1939 used two discrimination tests to compare a group of children with misarticulations to a group with no speech errors. Along with the Travis and Rasmus Test, he used a complex speech sound discrimination test which utilized sentences containing a nonsense word rather than pairs of nonsense syllables. The result of the comparison didn't indicate any significant differences between the two groups of subjects.

Mase (Powers, 1971, and Winitz, 1969) used two new discrimination tests in a study he conducted in 1946. The first test was a sentence form and the second was a list of paired words which were similar or contrasted. Rather than an examiner presenting the test items, Mase recorded the stimuli on a phonograph. The tests were administered to two groups of fifth and sixth grade boys with and without articulation errors. No significant difference was found for the paired-word test but a significant difference favoring the normal articulation group was found for the sentence test when the scores for both of the tests were compiled.

In 1950 Donewald (Powers, 1971) conducted a study presenting one hundred paired sounds to normal speaking and misarticulating children in the first and second grades. There was a significant difference in favor of the control group.

Kronvall and Diehl (1954) used the Templin Speech Sound Discrimination Test to compare two groups of children with and without articulation errors. A significant difference was found in favor of the control group.

Schiefelbusch and Lindsey (1958) introduced a new method of studying discrimination. They presented pictures to the subjects in

three different manners: 1) naming of the picture by the examiner, 2) naming of the picture aloud by the subject, and 3) naming of the picture silently by the subject. The test was administered to twenty-four first and second graders equally matched in control and experimental groups. The results indicated that the control group did better on the test, but all three dimensions of the test were equally difficult.

Using vowels, consonants, words, and phrases in discrimination tests, Clark (Winitz, 1969) found in 1959 that children with articulation errors performed significantly poorer than children without articulation errors. The vowel and consonant discrimination tests utilized word pairs and the word and phrase tests consisted of a series of picture cards.

Cohen and Diehl (1963) administered the Templin Speech Sound Discrimination Test to thirty children with articulation errors and thirty children without articulation erros, all in grades one, two, and three. Those children without errors performed significantly better on the test.

Sherman and Geith (1967) also used the Templin Speech Sound Discrimination Test in a study which used a slightly different procedure. Using this discrimination test, they identified children with exceptionally low and high discrimination scores. Then they administered the Templin and Darley Diagnostic Articulation Test to both groups. Those subjects with high discrimination scores had the fewest articulation errors.

Locke (1970), following a study concerning production and discrimination, concludes that "the relationship between production and perception in misarticulating children is slight and somewhat obscure" (p. 6) when considering specific phonemic contexts.

Aungst and Frick (1964) attribute the discrepancies in the results of the above studies to two factors. The first factor is that studies often use stimuli presented by the examiner and not the error sound produced by the subject. Powers (1971) also emphasizes the importance of distinguishing between inter-discrimination (discrimination of stimuli produced by another person) and intra-discrimination (discrimination between stimuli produced by the subject).

Power's position is also supported by a study conducted by Locke and Goldstein (Locke, 1970). In a study dealing with five year olds, they presented the subjects with six questions regarding a picture. Three of the questions contained the examiner's imitation of the child's misarticulations, and three used correct articulation. Their results indicated that "children correctly perceive correct productions regardless of their phoneme production. But children who misarticulate a phoneme also (generally) perceive their misarticulations as correct" (p. 6). Woolf (1971) also maintains the importance of this parameter in studies of auditory discrimination when he concludes that self-discrimination is more difficult than discriminating the productions of others.

The second factor asserted by Aungst and Frick is concerned with the inconsistencies of functional articulation errors. They argue that this consideration is often discarded in studies of auditory discrimination. They elaborate further on the inter-relationship of inter- and intra-discrimination and misarticulation inconsistencies by saying that the subject's ability to judge his own speech production is significantly related to the consistency of his speech errors. In an investigation by these two researchers about the relationship between production and

discrimination, they found that misarticulation of the /r/ phoneme was related to a specific, not a general, discrimination ability. Their study included twenty-seven children from the ages of eight to ten years with articulation errors. Each child's discrimination of the /r/ was tested by using the subject's right-wrong evaluation in three situations: 1) an immediate evaluation of his own responses, 2) an evaluation of his own responses when heard on a tape recording, and 3) an evaluation of his own responses when compared to the examiner's response when heard on a tape recording. This study took into account inter- and intra-discrimination during the test procedures. The inconsistencies of articulation errors were also controlled by investigating a specific phoneme rather than a general discrimination ability. The results of their findings indicate that the production and discrimination of the /r/ phoneme are related.

Several other studies have also been conducted to determine whether subjects with articulation errors might have a specific defect in their auditory discrimination corresponding to their mistakes in articulation. Templin (1943) was possibly the first to take this factor into account in a study of auditory discrimination. She found that children of all grades had the most difficulty discriminating phonemes in the medial and final positions and this correlated with an earlier study by Templin and Steer (Powers, 1971) which concluded that articulation errors are also more frequent in those positions.

Spriestersbach and Cutis (1951) directed a study done by Anderson in which children in kindergarten through the fourth grade with /s/ articulation errors were considered. Articulation tests were administered con-

taining the /s/ in different word positions and phonetic contexts, then a discrimination test was administered involving the same contexts. During the discrimination test the examiner produced each word used in the articulation test three times, imitating the subject's error sound for one of the productions. In the instance that the word was produced correctly by the subject, the examiner imitated a common misarticulation of the word. Results indicated that the subjects made more discrimination errors with the /s/ contexts which they misarticulated than those in which they had no errors.

After an extensive review of the research dealing with the inability to discriminate as a general and specific deficit, Powers (1971) summarizes that there doesn't appear to be a general defect in the speech sound discrimination of those with function articulation errors. Instead, those with misarticulations seem to have "at least limited and selective difficulties in sound discrimination, particularly in relation to the speech sound which they themselves misarticulate" (p. 861).

In summary, the following conflicts in design and analyses have been noted.

1. Some studies have assumed a general deficit in auditory discrimination is present, whereas others have dealt with it as a defect in regard to the misarticulated sounds only.
2. The studies have used subjects ranging in age from kindergarten to adulthood.
3. Stimuli ranging from nonsense syllables to words to sentences have been used.
4. Studies have required subjects to discriminate the examiner's productions, pre-recorded productions, and their own productions.
5. Experimental and control groups have included subjects with and without articulation errors, and they have used only subjects with errors.
6. Analyses have been made comparing articulation test scores to scores for auditory discrimination tests.

7. The degree of difficulty with which a subject discriminates different types of stimulus presentation has been analysed by some.
8. Analyses have been computed between different types of stimulus items used.
9. Individual as well as several phonemes have been viewed for analyses.

It appears, therefore, important to further investigate the following parameters of auditory discrimination.

1. Due to the inconsistencies in articulation errors, it seems that auditory discrimination should be examined as a specific deficit to determine its true relationship to articulation errors.
2. As stated earlier, auditory discrimination is a maturational process which peaks at about nine years of age. If this is the case, in order to rule out age as a contaminating variable, children over nine years of age or adults should be included.
3. There is no evidence to indicate which stimulus method is best, but Wepman (1967) suggests that the stimulus should be meaningful to the subject.
4. Only a few studies have dealt with the concept of self-discrimination. Most at this point, have been concerned primarily with how the subject discriminates the productions of others. In fact, all present tests of auditory discrimination test under this condition. It seems necessary to further investigate a person's perception of his own errors in order to determine its actual relationship to his own articulation errors.
5. Most studies have used an experimental group consisting of subjects with articulation errors and a control group containing subjects without errors. In this selection, group differences could be caused by factors other than auditory discrimination. There appears to be a need to control the two groups more narrowly by using subjects as their own controls.

The role of auditory discrimination in regard to articulation errors needs to be investigated further using these aspects as guides.

PHONETIC CONTEXT

Of all the approaches introduced and utilized in the field of speech pathology, one has appeared intermittently throughout and remains today. That is the idea of phonetic context. It has long been noted that

articulation errors are inconsistent, because some contexts appear to be more facilitating to the correct production than others. Spriestersbach and Curtis (1951) were among the first to begin an accumulation of information regarding the inconsistencies of articulation errors. They compiled information from studies done by Hale, Nelson and Buck. In their studies, Nelson found 53.4%, Hale found 73.3%, and Buck found 94.5% of the subjects tested had inconsistent articulation errors. Powers (1971) states that "dependency on phonetic context demonstrated in these studies accounts to some extent for the inconsistencies which we observe in misarticulations. These research findings also point up the importance of making a thorough evaluation in every case of functional articulation disorders not only of the specific sound misarticulated but also of the specific phonetic contexts in which misarticulations occur and in which the sounds are produced correctly" (p. 848).

Spriestersbach and Curtis carried these findings one step further and concluded that these inconsistencies are governed by variables in a systematic fashion. McDonald (1964) utilized this information for clinical purposes by the formation of a deep test of articulation which tests an error sound in different contexts occurring in words. In this deep test, McDonald controls the contexts for two variables: 1) syllabic position and 2) frequency of occurrence. He considers the two syllabic positions to be releasing and arresting, and he tests those contexts which a subject would most frequently use.

Griffith and Miner (1973), Ettinger (1973), and Schneider (1973) add another variable to this list, and that is syllabic stress. Following a review of the literature concerning this variable, Griffith and Miner

summarize stress as "the product of an overall energy increase in the entire phonatory mechanism" (p. 11). Ettinger resolves that syllabic stress has a notable influence on phoneme production and, therefore, should be considered along with misarticulations. Schneider also concludes that "interactions of position and stress were more important factors of the context's correct production" (p. 60).

Griffith and Miner have combined the four variables of frequency of occurrence, syllabic stress, syllabic position, and phonetic context to form the Griffith and Miner Test of Articulation Ability (Griffith and Miner, 1973). In their test, they consider the syllable to be the unit of analysis. The syllables they use are controlled for the above variables and chosen from the first one thousand most frequently occurring English words. The selection of the words was based on Zipf's law, which "predicts that some phonetic contexts occur with much greater frequency than others" (Griffith and Miner, 1973, p. 2). These authors extend the scope of Zipf's law and conclude that the "assessment of articulation behavior should focus on those contexts occurring with high frequency" (Griffith and Miner, 1973, p. 2). In reviewing current articulation tests, they have found that none of these tests have taken this factor into account. So, in essence, a child's speech would be tested for errors he seldom uses in everyday communication if tested by present articulation tests. It is the opinion of this author that Griffith and Miner's approach to articulation testing is at least a partial solution to the controversy concerning methods of testing errors in articulation.

If the phonetic context approach to articulation testing is accepted as being a valid measure of the subject's errors in production,

then it seems that at this point, it can also be applied to auditory discrimination. If a direct relationship between perception and production is to be assessed, then the two should be measured on a one to one basis, i.e., contextually. Therefore, by applying phonetic context to research concerning auditory discrimination, this can be accomplished.

CHAPTER III

PROCEDURE

Selection of Subjects

Subjects for this study included six Oriental adults who are using English as a foreign language. Intelligence, age, hearing, articulation, and previous therapy were controlled as variables in the following manner:

1. Intelligence: Only subjects with average intelligence were included in this study. This was accomplished by only including adults who are enrolled in classes at Eastern Illinois University.
2. Age: Several researches have indicated that discrimination skills increase with age, and that this maturational process normally ends at about the age of nine years. Therefore, to control age as a variable, only adults age eighteen and over were included.
3. Hearing: An audiometric screening test was administered to all subjects. All subjects responded positively to tones presented at 25dB (ISO, 1964) for the frequencies 250-8000Hz.
4. Articulation: Each subject exhibited an articulation disorder of the /r/ phoneme which was not from a known organic cause. In order to determine whether or not auditory discrimination is a specific or a general ability, each subject

was used as his own control. To do this, the above subjects did not have /s/ articulation errors. In this way, auditory discrimination was assessed on the basis of misarticulation of the /r/ (experimental set) and correct articulation of the /s/ (control set) for the same subject.

The study by Aungst and Frick (1964) cited earlier offers justification for also including subjects with other misarticulations besides the /r/ phoneme. They concluded that the /r/ errors were related to a specific and not a general deficit in auditory discrimination. Therefore, it would follow that each error would be independent of the others in terms of auditory discrimination ability.

Locke (1970) offers support for using each subject as his own control. He states that one of the faults of previous studies is the use of two extreme groups in which one had normal articulation and the other had articulation errors. He argues that the study differences between the two extreme groups could easily be due to factors other than discrimination difficulties. Furthermore, the production-discrimination behavior of each subject may or may not match on a contextual basis.

The Fisher-Logemann articulation test was administered to determine which phonemes were misarticulated. To determine which /r/ contexts were misarticulated, the Griffith and Miner Test of Articulation Ability for the /r/ phoneme was administered.

5. In order to eliminate the possibility of previous therapy in auditory discrimination, no subjects had had previous articulation therapy for any phoneme.

Inter-examiner Reliability

Inter-examiner reliability during the test session was established as follows. Tape recordings were made of the administration of the Fisher-Logemann Articulation Test and the Griffith and Miner Test of Articulation Abilities to three of the six subjects. At a later date a graduate student in speech pathology who had administered at least three articulation tests to Oriental clients listened to the tape recordings. At that time she recorded her judgments of the subjects' articulation errors on standardized score sheets identical to those used during the test session. To determine inter-examiner reliability, a per cent agreement index was computed between the examiner's judgment of the articulation errors and the judgment of the graduate student.

Methodology

1. A series oftwenty-four words with /r/ contexts were chosen as stimuli to be presented to the experimental set. These words were chosen on the basis of the following variables considered in Griffith and Miner's approach to phonetic context: a) frequency of occurrence, b) syllabic stress, c) syllabic position (Griffith and Miner, 1973). The stimulus words to be presented were chosen from those presented in the Griffith and Miner Test of Articulation Ability for the /r/ phoneme in single contexts. This list was chosen because it contains initial accented, initial unaccented and final accented con-

TABLE 1

STIMULUS WORDS USED FOR THE
EXPERIMENTAL AND CONTROL SETS

WORD	CONTEXT	TYPE	WORD	CONTEXT	TYPE
rich	rI	I/A	six	sI	I/A
red	rɛ	I/A	seven	sɛ	I/A
real	ri	I/A	see	si	I/A
race	re	I/A	say	se	I/A
ride	raI	I/A	sign	saI	I/A
road	ro	I/A	so	so	I/A
room	ru	I/A	soon	su	I/A
ran	ræ	I/A	sat	sæ	I/A
run	rʌ	I/A	sun	sʌ	I/A
round	ra	I/A	sound	sa	I/A
rock	rɑ	I/A	soil	sɔI	I/A
wrong	rɔ	I/A	saw	sɔ	I/A
Henry	rI	I/UA	success	sə	I/UA
several	r	I/UA	supply	sə	I/UA
railroad	ro	I/UA	also	so	I/UA
bear	ɛr	F/A	yes	ɛs	F/A
clear	Ir	F/A	peace	is	F/A
war	ɔr	F/A	possible	ɑs	F/A
car	ɑr	F/A	kiss	Is	F/A
four	or	F/A	voice	ɔIs	F/A
sure	Ur	F/A	produce	Us	F/A
carry	ær	F/A	pass	æs	F/A
tire	aIr	F/A	face	es	F/A
hour	aur	F/A	house	aus	F/A

texts which were selected on the basis of the /r/ contexts found in the first one thousand most frequently occurring English words. Since the words in the list were from the first one thousand most frequently used words, then they were also readable for the selected subjects.

A series of twenty-four words with /s/ contexts were chosen as stimuli to be presented to the control set. These were also chosen on the basis of Griffith and Miner's phonetic context variables. The /s/ stimulus words were chosen from the Griffith and Miner Phonetic Context Inventory (1973) of the first one thousand most frequently occurring words containing /s/ contexts. The /s/ stimulus words were matched with the /r/ stimulus words for syllabic stress and position.

2. Experimental Set: The experimental set consisted of two sections: 1) the subject's spontaneous response to stimuli, and 2) the subject's imitative response to stimuli.

Spontaneous Responses: Each subject recorded his spontaneous responses (SR) to /r/ stimulus words in the following manner. Each stimulus word was printed on a 3 x 5 inch card. A table of random numbers (Downie and Heath, 1970, pp. 328-329) was used to select the order of presentation of the stimulus words. As each card was handed to the subject, the subject was instructed to say the word on the card when he was signalled by a light box. The responses were then recorded on 3 7/16 x 9 inch language master cards by the following method. As the language master card was placed in a Bell

and Howell Language Master (M717), a light box signalled to the subject to say the stimulus word printed on the 3 x 5 inch card. One response was recorded on each language master card. The same procedure was followed to record all twenty-four stimulus words and for all six subjects.

Identical language master cards were used to record the examiner's (E) correct production of the stimulus words and another adult's (O) common misarticulation of the error phoneme. So that the subject would not recognize the E and O productions each time as being that of the person conducting the study and judge them as correct on that basis, the author chose two other adults to record E and O productions. O productions were made by another Oriental college student not included in the study as a subject.

Imitative Responses: The imitative responses (IR) were recorded in the same manner as the spontaneous responses with the following exception. Rather than the subject reading the stimulus word from a card, the examiner said the stimulus word, and the subject repeated the word when signalled by the light box. The order of presentation of the stimulus words was determined by a table of random numbers (Downie and Heath, 1970, pp. 328-329). The latency period between stimulus and response (Romans and Milisen, 1954) was never less than three seconds or greater than six seconds.

3. Control Set: The same procedure used during the experimental set was used during the control set. The stimulus words pre-

sented, however, contained /s/ contexts and not /r/ contexts. The stimulus words were presented in a random order as selected from a table of ransom numbers (Downie and Heath, 1970, pp. 328-329). Since the subjects did not misarticulate the /s/ contexts, the spontaneous response session was left out of the control set, because it was assumed there would be no difference in their spontaneous and imitative responses. The imitative responses remained because of their similarity to responses during therapy sessions.

Recording Session

During the recording session, the subjects listened to each of the language master cards recorded during the experimental and control sessions and designated whether the production were correct or incorrect. The three sets of stimulus words and the three productions (E, O, S) for each word were presented in a randomly selected order for each stimulus word through the use of a table of random numbers (Downie and Heath, 1970, pp. 328-329). The subjects indicated correct responses in the following manner. A light box was placed in front of each subject, and he was instructed to press the light on the instant he thought he heard the word on the card said correctly. Before each language master card was placed in the machine, the subject was given a card with the stimulus word printed on it to orient him to the task. The examiner recorded the subject's correct or incorrect responses on a response sheet. The subjects were not reinforced by the examiner for correct responses.

Recording of Responses

The subjects' responses during the recording session were recorded by the examiner as follows. Each time a subject indicated by turning on the light that he perceived the E, O, or S production of one of the twenty-four stimulus words in each set as correct a + was recorded on the score sheet for that word next to the corresponding stimulus source. After the session, the subjects' judgments were compared to the original Griffith and Miner Test of Articulation Ability score sheets. Those contexts which each subject misarticulated on the test but which he judged as correct were marked as errors. If he indicated that a context was produced incorrectly which the test indicated that he produced correctly, and error was scored. Those contexts which were perceived as correct and produced correctly were scored as correct. Since all E productions were articulated correctly, those which the subject judged as wrong were scored as errors. Since all O productions were misarticulated, those which the subject judged as correct were scored as errors. For each of the stimulus presentations (E, O, S), there was a possible twenty-four correct answers. This was a total of seventy-two correct responses for each set of stimulus words (spontaneous /r/, imitative /r/, and imitative /s/).

Verbal Directives for Sessions

Experimental Set: The following directions for the sessions in the Experimental Set were read to each subject.

1. Spontaneous Responses /r/: I am going to give you a list of thirty words (including twenty-four stimulus and six practice words). Just look at them, but don't say any of them out loud. Are there any that you don't know?

   Now I will present twenty-four cards to you one at a time. Each card will have one of the words on the list on it. As I hand you a card, I will place a card in the machine like

this. (Demonstrate) When I put the card in, the light will go on like this. (Demonstrate) When the light goes on, I want you to say the word on the card I have given you. Do the same thing for each word. Let's practice a few times with these cards. (Demonstrate)

2. Imitative Responses /r/: Now I am going to say twenty-four words to you. After I say each word I will put another card in the machine. As I do this, the light will come on like this. (Demonstrate) When the light comes on, I want you to repeat the word I have just said. Let's practice a few times. (Demonstrate)

Control Set: The following directions were read to each subject prior to the session in which the imitative productions were recorded.

> Next, I am going to say twenty-four different words. Do the same thing with these words that you did with the last ones. Repeat the word when the light comes on.

Recording Session: The following directions were read to the subjects at the beginning of the recording session.

> You will be listening to three people saying three different groups of seventy-two words. One of the voices you hear will be your own. Each of the words is printed on these cards. I will hand you a card with a word on it, and you will then hear the word said three times. Whenever you hear the word said correctly, push this button to turn on this light like this. (Demonstrate) If you think the word is wrong, don't push the button. Only push the button for the right word. Let's practice a few times with these cards. (Demonstrate)

Analysis of Data

The following statistical analyses were computed to answer the questions posed by this study.

1. Do statistically significant differences exist among the types of stimulus presentation and among the response modes for auditory discrimination scores of the experimental set?

The Friedman two-way analysis of variance by ranks (Siegel, 1956) was computed to test the null hypothesis that there was no significant

difference for the auditory discrimination scores between the three types of stimulus presentation (E, O, S) and the two response modes (spontaneous and imitative) of the experimental set.

2. Do statistically significant differences exist between the types of stimulus presentations for auditory discrimination scores of the control set?

The Kruskal Wallis one-way analysis of variance (Downie and Heath, 1970) was computed to determine if there was a significant difference between the auditory discrimination scores of the three types of stimulus presentation (E, O, S) of the control set. To determine the relationship between these types of stimulus presnetation, the Mann-Whitney U test for two independent variables (Siegel, 1956) was computed for the following combinations of stimulus presentations--E and O, E and S, and S and O.

3. Do statistically significant differences exist between the types of stimulus presentations (E, O, S) for auditory discrimination scores of the control set?

To determine if there was a statistically significant difference between the auditory discrimination scores for the stimulus presentations (E, O, S) for the imitative of the experimental and control sets, the Friedman two-way analysis of variance by ranks (Siegel, 1956) was applied.

4. Do statistically significant differences exist between articulation errors and auditory discrimination scores for the /r/ contexts in the experimental set?

The X^2 (Siegel, 1956) test for independent samples was computed to determine if there was a statistically significant difference between the misarticulations of the /r/ and auditory discrimination of the /r/ in the contexts which were misarticulated.

CHAPTER IV

RESULTS AND DISCUSSION

This study examined the relationship between the production errors and the auditory discrimination abilities of six Oriental adults using English as a foreign language. All subjects misarticulated the /r/ in several contexts and produced the /s/ correctly in all contexts. Each subject was required to make judgments while listening to three types of stimulus presentations and two response modes. The stimulus presentations included in an experimental set were the subject's productions, another adult's correct productions, and another Oriental adult's incorrect productions of twenty-four stimulus words containing the /r/ phoneme. A control set included the same three stimulus presentations, except this time each produced the correct articulation of stimulus words containing the /s/ phoneme. The subject's productions included two response modes in the experimental set--spontaneous and imitative--and one response mode in the control set--imitative. Each subject's raw score from the stimulus conditions served as the data for further analyses.

Inter-examiner Reliability

To establish the degree of inter-examiner reliability, a per cent agreement index was computed between the author's judgment of correct productions for the Griffith and Miner Test of Articulation Abilities for the /r/ phoneme (Griffith and Miner, 1973) and another graduate student's

judgment of correct responses when listening to a tape recording of the test session at a later date. The resulting agreement value of 99 per cent was interpreted to indicate a high degree of inter-examiner reliability.

Analysis of Data

Experimental Set: The Friedman two-way analysis of variance by ranks (Siegel, 1956) was applied to test the null hypothesis that there were no significant differences between the types of stimulus presentations (E, O, S) and the response modes (spontaneous and imitative) for the subjects' discrimination of the error phoneme /r/. To compute this analysis, the subjects' errors for the three stimulus presentations and the two response modes were summed and ranked. The resulting X_r^2 value of 4 has a probability value of .167, which is greater than the .05 level of significance. Therefore, the null hypothesis was accepted, and there were no statistically significant differences between the three stimulus presentations and the two response modes when the subjects discriminated their error phoneme.

To determine if there was a statistically significant difference between the subjects' production errors of the /r/ and their auditory discrimination of the /r/, the X^2 test of two independent samples (Siegel, 1956) was computed. To make the analysis, the discrimination scores for those contexts which were misarticulated were tallied for all subjects for all three stimulus presentations and both response modes. The results disclosed that there were no statistically significant differences between the production errors and discrimination skills at the .05 level of sig-

nificance. This indicates that the subjects did not demonstrate difficulties with auditory discrimination which were related to the specific contexts which they misarticulated.

Control Set: To test the null hypothesis that there were no statistically significant differences between the three types of stimulus presentations when the subjects discriminated the /s/ phoneme, which they articulated correctly, the Kruskal-Wallis H test (Downie and Heath, 1970) was computed. The resulting H value of 10.83 rejected the null hypothesis at the .05 level of significance. In other words, the subjects did not perceive the E, O, and S productions of the sound they articulated correctly as being the same. To determine the relationship between these three stimulus methods, the Mann-Whitney U test for two independent samples (Siegel, 1956) was computed between the following combinations of stimulus presentations--E and S, E and O, and S and O. Results indicated that each stimulus presentation differed significantly from the other at the .05 level of significance. The three stimulus presentations of the /s/ stimulus words rank ordered themselves in regard to ease of discrimination with the E productions being the easiest to discriminate, next the S productions, and the O productions being the most difficult to discriminate. This revealed that when the subjects listened to the three stimulus methods, they had the least amount of difficulty identifying correct productions made by the examiner and the most difficulty identifying correct productions made by the other adult.

Between the Experimental and Control Sets: The Friedman two-way analysis of variance by ranks (Siegel, 1956) was applied again to determine the relationship between the error phoneme in the experimental set and the

correct phoneme in the control set. Since there were no spontaneous productions for the /s/ stimulus words, the analysis was computed for the three stimulus presentations and the imitative productions of the /r/ (experimental set) and the /s/ (control set) stimulus words. The results indicated that there were no statistically significant differences at the .05 level of significance between the subjects' discrimination of the error phoneme and the correct phoneme when presented by the three stimulus methods. In other words, when the subjects listened to stimulus items containing the correct or the incorrect phonemes, they were able to discriminate all three stimulus presentations with equal ease.

Research Implications

In the present study, the following were controlled as variables because past research had indicated a need for their being included.

1. Age: To eliminate the influence maturation might have on auditory discrimination, adult subjects were used for this study.
2. Articulation: To control for the inconsistencies in articulation errors and to view auditory discrimination as a defect related to a specific phoneme, only errors of the /r/ phoneme were included in the analyses.
3. To control extraneous variables, each subject was used as his own control.
4. Stimulus items: The stimulus words selected for this study are from the first one thousand most frequently used English words and therefore familiar to the subjects.
5. Stimulus presentations: To determine the importance of methods of stimulus presentations, an examiner's correct production of the stimulus item (E), another adult's production of a common misarticulation of the stimulus item (O), and the subject's own production ot the error sound (S) were used for comparison.
6. Previous therapy: The subjects included in this study had not been enrolled in articulation therapy previously to eliminate the possibility that they may have already been trained in auditory discrimination.

Of the previously reviewed studies, only four used subjects as their own control and dealt with the concept of auditory discrimination as

a specific disability involving only those phonemes the subjects misarticulated. These are the studies conducted by Aungst and Frick (1964), Locke and Goldstein (Locke, 1970), Spriestersbach and Curtis (Winitz, 1969) and Woolf (1971). These studies also attempted to eliminate the use of unfamiliar stimulus items by using words rather than nonsense syllables. However, the meaningfulness was not as narrowly controlled as in the present study.

All four studies controlled age as a variable; however, none of the subjects were over ten years of age. This author feels that a maturational factor could have still influenced these study results.

Of the four studies, Aungst and Frick (1964) and Woolf (1971) used subjects who were enrolled in speech therapy at the time of the study. Neither Locke and Goldstein (Locke, 1970) or Spriestersbach and Curtis (1951) mentioned this variable, so it is doubtful that they manipulated it during their studies.

The major conflict among these four studies and between the four and the present study is the method of stimulus presentation. Table 2 illustrates the various methods used in the present study as well as in the other four studies.

The fact that several variables were either not considered or considered in only some of the previous studies cited, seems to in part account for the conflicting results obtained for the four studies. The present study, however, attempted to control for as many variables as possible, and concluded with results which are at least partially supported by each of the other four studies. The finding in this study that there is no significant difference between the stimulus presentations of the error phoneme

TABLE 2

METHODS OF STIMULUS PRESENTATION

Study	Stimulus	Results
Aungst and Frick	a. immediate evaluation of subject's own productions b. subject's own productions on a tape recording c. tape recording of subject's productions and examiner's correct productions	a. no differences between stimulus presentations b. phoneme and discrimination related
Locke and Goldstein	a. examiner's correct production b. examiner's imitation of subject's error	a. subject's correctly perceived correct productions b. subjects perceived own errors as correct
Spriestersbach and Curtis	a. examiner's correct production b. examiner's imitation of a common error c. examiner's imitation of subject's error	c. phoneme and discrimination not related discrimination and phoneme related
Woolf	a. sound evaluation b. tape recording of subject's productions c. tape recording of subject's productions and examiner's correct and incorrect productions	a. self-discrimination more difficult than discriminating others b. phoneme and discrimination not related
Present Study (experimental set)	a. examiner's correct productions b. another adult's common error c. subject's production	a. no differences between stimulus presentations b. error sound not related to discrimination ability

is supported by Aungst and Frick (1964). However, Aungst and Frick (1964) and Spriestersbach and Curtis (1951) also indicate that there is a relationship between auditory discrimination and the error phoneme, and the present study found no relationship here. The results of the present study in regard to the latter issue, on the other hand, is supported by Locke and Goldstein (Locke, 1970) and Woolf (1971).

The fact that the present study revealed a significant difference and a rank ordering for the stimulus presentations during the control set, appears to add another dimension to the conflicting results above. These results suggest that the auditory discrimination of one sound may not be the same as the auditory discrimination of another sound. And when the results are viewed in light of the results of the experimental set and the other four studies, another conclusion can be made. Perhaps the method of stimulus presentation is not related to the sound presented, but to the individual listener. If this is considered to be true, then groups of listeners will not perceive or discriminate any two stimulus presentations the same. In other words, unlike articulation, auditory discrimination can't be seen and is far more difficult to measure and control in research. These conclusions are supported by Weiner (1967), who also suggests that the more errors in articulation the subject presents, the more positive the relationship between production and discrimination. Of the five studies in Table 2, only the study conducted by Woolf controlled for the severity of the sound being investigated.

These conclusions indicate a need for further studies which narrowly control the following variables as well as the variables controlled in the present study.

1. The number of contexts containing the error sound should be controlled.
2. Replications of a given study should use the same procedures but different subjects to determine the relationship between auditory discrimination and individual differences.
3. Various phonemes should be studied under identical research conditions to determine the relationship of auditory discrimination to various phonemes.

Clinical Implications

Although some of the results of this study didn't reveal statisically significant differences, observation of the results indicates differences that could possibly be of clinical importance. Table 3 illustrates the relationship between each of the subjects and the stimulus presentations for the experimental and control sets. This information demonstates that in a therapy situation, the clinician might find it helpful to evaluate each client's auditory discrimination skills by a method similar to the one used in this study. For example, subject one appears to have difficulty discriminating the error productions when presented by another person (O), but doesn't seem to have as much difficulty discriminating her own productions (S) or the correct productions presented by another person (E). When comparing the error phoneme (experimental set) to the correct phoneme (control set), this subject does have a considerable amount of difficulty with the error sound. This information could be very useful in determining what approaches would be used to help this subject improve his auditory discrimination skills.

Present tests of auditory discrimination using only the examiner's correct production of stimuli which may or may not contain the subject's error phoneme, would have failed to indicate a need for training with auditory discrimination for subject one. This study, therefore, indicates a

TABLE 3

SUMMARY OF DISCRIMINATION
SCORES FOR ALL SUBJECTS

STIMULUS PRESENTATIONS	SUBJECTS 1	2	3	4	5	6
Experimental Set						
Spontaneous /r/						
Examiner	2	4	0	0	3	2
Other	8	10	14	18	12	6
Subject	3	10	7	8	12	6
Imitative /r/						
Examiner	1	2	0	0	1	3
Other	20	13	18	15	13	12
Subject	3	7	9	6	8	6
Control Set						
Imitative /s/						
Examiner	0	0	0	0	4	2
Other	1	1	1	0	7	7
Subject	0	0	0	1	11	3

definite need for the development of auditory discrimination tests which are a more individualized and valid measure of auditory discrimination.

Summary

In summary, the following conclusions were derived from this study.

1. When considering the error phoneme, no relationship was found between the misarticulated sound and the methods of stimulus presentations or between the error phoneme and the subjects' discrimination ability.
2. When considering the phoneme which was articulated correctly, a relationship was found between the phoneme and the way in which the subjects discriminated different stimulus presentations. The examiner's productions were the easiest for the subject to discriminate, next their own correct productions, and finally, the other Oriental adult's productions.
3. The subjects were able to perceive the stimulus presentations for the error phoneme and correct phoneme with equal ease.
4. It appears that all sounds may not be discriminated the same.
5. Discrimination may be an individual capability that is difficult to measure on a group basis.
6. Present tests of auditory discrimination fail to measure certain dimensions which may be important for clinical use.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the relationship between the articulation and the auditory discrimination skills of six Oriental adults using English as a foreign language. Each of the subjects discriminated stimulus words presented by three stimulus presentations and two response modes. Their raw scores obtained from these conditions were used later as data for further analyses.

The study was divided into two sets using the same subjects in each set. The experimental set was concerned with the subjects' incorrect productions of the /r/. The control set dealt with the subjects' correct productions of the /s/.

All six subjects participating in this study were enrolled at Eastern Illinois University. All subjects passed a pure tone audiometric screening test at 25 dB for the frequencies 500-8000 Hz and had not been enrolled in articulation therapy at any time previous to this study. Each subject misarticulated the /r/ phoneme in several contexts tested and articulated the /s/ phoneme correctly in all contexts.

Twenty-four /r/ and twenty-four /s/ stimulus words were selected for presentation in this study on the basis of frequency of occurrence, syllabic stress, and syllabic position. All stimulus words were selected from the first one thousand most frequently used English words. Only

words containing initial accented, final accented, and initial accented single contexts were selected.

The study consisted of three sessions--a test session, a response session, and a recording session. Subjects were selected during the test session on the basis of the above criteria and the results of the Fisher-Logemann Articulation Test and the Griffith and Miner Test of Articulation Abilities for the /r/ phoneme. During the response session, each subject recorded his spontaneous and imitative productions of the /r/ stimulus words for the experimental set and his imitative productions of the /s/ stimulus words for the control set. The recording session required each subject to listen to three productions of each of the twenty-four stimulus words in both the spontaneous and the imitative parts of the experimental set and the twenty-four stimulus words for the control set--a total of seventy two stimulus items. The three presentations of each stimulus word for the experimental set consisted of the subject's production (S), another adult's production (E), and another Oriental adult's common misarticulation of the error phoneme in the stimulus word (O). The three stimulus presentations of each stimulus word for the control set included the subject's correct production (S), another adult's correct production (E), and another Oriental adult's correct production of the /s/ phoneme in the stimulus words (O).

After the session each subject's judgment was compared to his original Griffith and Miner Test of Articulation Abilities test results. Those contexts which the subject misarticulated on the test but judged as correct were marked as errors. If he indicated that a context was produced incorrectly which the test indicated he produced correctly, an error was

scored. Those contexts which were perceived as correct and produced correctly were scored as correct. Since all E productions were articulated correctly, those which the subject judged as wrong were scored as errors. Since all O productions in the experimental set were misarticulated, those which the subject judged as correct were scored as errors. In the control set, all O productions were correct, so those which the subject judged as incorrect were scored as errors. For each of the stimulus presentations (E, O, and S), there were twenty-four correct answers possible. This was a total of seventy-two correct responses for each set of stimulus words (spontaneous /r/, imitative /r/, and imitative /s/).

The following statistical analyses were computed to answer the questions posed by this study.

1. Do statistically significant differences exist among the types of stimulus presentation and among the response modes for auditory discrimination scores of the experimental set?

The Friedman two-way analysis of variance by ranks was applied to test the null hypothesis that there were no significant differences between the types of stimulus presentation and the response modes for the subjects' discrimination of the error phoneme /r/. The resulting X_r^2 value of 4 has a probability value of .167, which is greater than the .05 level of significance. Therefore, the null hypothesis was accepted; there were no statistically significant differences between the three stimulus presentations and the two response modes when the subjects discriminated their error phoneme.

2. Do statistically significant differences exist between the types of stimulus presentations for auditory discrimination scores of the control set?

The Kruskal-Wallis H test was computed to test the null hypothesis that there were no significant differences between the types of stimulus presentation for the subjects' discrimination of the correctly articulated /s/ phoneme. The resulting H value of 10.83 is significant at the .05 level. The null hypothesis was, therefore, rejected. In other words, the subjects did not perceive the E, O, and S productions of the sound they articulated correctly as being the same. To determine the relationship between these three stimulus methods, the Mann-Whitney U test for two independent samples was computed between the following combinations of stimulus presentations--E and S, E and O, and S and O. Results indicated that each stimulus presentation differed significantly from the other at the .05 level of significance. The three stimulus presentations of the /s/ stimulus words rank ordered themselves in regard to ease of discrimination with the E productions being the easiest to discriminate, next the S productions, and the O productions being the most difficult to discriminate. This revealed that when the subjects listened to the three stimulus methods, they had the least amount of difficulty identifying correct productions made by the examiner and the most difficulty identifying correct productions made by another adult.

3. Do statistically significant differences exist between the auditory discrimination scores of the experimental set and the control set?

The Friedman two-way analysis of variance by ranks was applied to test the null hypothesis that there were no statistically significant differences between the auditory discrimination scores of the experimental and control sets. The result indicated that there were no statistically significant differences between the subjects' discrimination of the error phoneme and the correct phoneme when presented by the three stimulus

presentations. In other words, when the subjects listened to stimulus items containing the correct or the incorrect phonemes, they were able to discriminate all three stimulus presentations with equal ease.

4. Do statistically significant differences exist between articulation scores for the /r/ contexts in the experimental set?

To test the null hypothesis that there were no statistically significant differences between the subjects' production errors of the /r/ and their auditory discrimination of the /r/, the X^2 test for two indepndnet samples was computed. The results indicated that there were no statistically significant differences between the production errors and the discrimination skills. The subjects did not demonstrate difficulties with auditory discriminations which were related to the specific contexts which they misarticulated.

When comparing this study to the studies by Aungst and Frick (1964), Locke and Goldstein (Locke, 1970), Spriestersbach and Curtis (Winitz, 1969) and Woolf (1971), it appears that the present study controlled several variables more narrowly than the other four studies did. Although the four viewed auditory discrimination as a disability related to a specific phoneme and used subjects as their own controls, they do not appear to have adequately controlled for maturation, previous therapy, or the meaningfulness of the stimulus items. These considerations plus the various methods of stimulus presentation used by the present study and the other four studies have produced conflicting and often contradictory results. The fact that the results for the control set of this study, which dealt with correct productions, were the same as various results of the other four studies, which dealt with error productions, reveals some new con-

cepts in dealing with auditory discrimination. These results suggest that:

1. The auditory discrimination of one sound may not be the same as the discrimination of another sound.
2. The method of stimulus presentation is not related to the sound presented, but to the individual listener. Groups of listeners will not perceive or discriminate any two stimulus presentations the same.
3. Auditory discrimination doesn't provide the examiner with any visual or auditory information and, therefore, is far more difficult to measure and control in research than articulation.

The results of this study also reveal some aspects of auditory discrimination which may be clinically significant even though they weren't statistically significant. The auditory discrimination scores for each subject demonstrate that most had more difficulty discriminating the error phoneme than the one they articulated correctly. It also appears that they had the least difficulty discriminating the examiner's correct productions and the most difficulty discriminating their own productions and the other Oriental adult's imitation of the incorrect production. These difficulties, however, varied from subject to subject suggesting that each client's discrimination skills should be analysed on an individual basis such as that presented here. Present tests of auditory discrimination would have failed to indicate deficient auditory discrimination skills for several of the subjects in this study.

It is suggested that future studies investigating auditory discrimination control the variables presented in this study as well as the following variables.

1. The number of contexts containing the error phoneme should be controlled.
2. Replications of a given study should contain different subjects to determine the relationship between auditory discrimination and the individual.

3. Various phonemes should be studied under identical research conditions to determine the relationship of auditory discrimination to various phonemes.

APPENDIX A

RANDOM ORDERING FOR THE RESPONSE SESSION

Spontaneous /r/	Imitative /r/	Imitative /s/
wrong	war	peace
railroad	road	voice
carry	bear	kiss
tire	sure	house
rich	ran	produce
room	car	yes
round	clear	seven
red	wrong	soon
ride	room	say
ran	tire	supply
clear	rock	pass
war	race	face
hour	ride	sign
rock	carry	success
race	real	saw
four	four	six
run	Henry	sound
sure	railroad	sun
several	rich	so
Henry	hour	possible
real	round	soil
road	red	sat
bear	several	see
car	run	also

APPENDIX B

RANDOM ORDERING FOR THE RECORDING SESSION
OF THE EXPERIMENTAL SET

Spontaneous /r/				Imitative /r/			
Word	Stimulus Presentation			Word	Stimulus Presentation		
room	E	S	O	ran	S	E	O
carry	S	O	E	Henry	O	S	E
hour	O	E	S	clear	S	E	O
rock	E	S	O	real	E	S	O
race	O	S	E	room	S	O	E
car	E	S	O	sure	E	S	O
round	S	E	O	four	O	E	S
sure	O	S	E	ride	E	O	S
wrong	O	S	E	car	S	E	O
war	S	O	E	railroad	O	S	E
several	S	E	O	red	E	O	S
Henry	E	O	S	rock	O	S	E
red	E	S	O	wrong	E	S	O
ride	O	E	S	hour	O	S	E
four	O	S	E	road	E	O	S
run	E	O	S	rich	S	E	O
real	E	S	O	several	E	S	O
railroad	S	E	O	race	O	E	S
road	E	S	O	run	E	S	O
rich	S	O	E	round	S	E	O
clear	E	O	S	bear	O	E	S
bear	O	S	E	tire	S	O	E
tire	S	E	O	war	S	E	O
ran	E	S	O	carry	E	S	O

RANDOM ORDERING FOR THE RECORDING SESSION
OF THE CONTROL SET

Imitative /s/

Word	Stimulus Presentation		
also	S	E	O
soil	E	S	O
sun	S	O	E
sound	O	S	E
seven	S	O	E
sign	O	E	S
soon	E	S	O
see	S	E	O
supply	E	O	S
yes	E	S	O
so	O	S	E
sat	S	O	E
possible	E	S	O
peace	O	E	S
produce	S	E	O
saw	E	O	S
voice	S	O	E
house	O	S	E
kiss	S	O	E
pass	S	E	O
success	O	S	E
face	E	S	O
six	E	O	S
say	O	E	S

BIBLIOGRAPHY

Aungst, L., and Frick, J. "Auditory Discrimination Ability and Consistency of Articulation of /r/." Journal of Speech and Hearing Disorders 29 (February, 1964): 76-85.

Backus, O., and Beasley, J. Speech Therapy with Children. Boston: Houghton Mifflin Company, 1951.

Cohen, J., and Diehl, C. "Relation of Speech Sound Discrimination Ability to Articulation Type Speech Defects." Journal of Speech and Hearing Disorders 28 (May, 1963): 187-190.

Dickson, S. "Differences Between Children Who Spontaneously Outgrow and Children Who Retain Functional Articulation Errors." Journal of Speech and Hearing Research 27 (September, 1962): 263-71.

Downie, N. M., and Heath, R. W. Basic Statistical Methods. New York: Harper and Row, 1970.

Ettinger, Karen. "A Phonetic Context Approach to Articulation Therapy for /r/." Master's thesis, Eastern Illinois University, 1973.

Farquhar, M. "Prognostic Value of Imitative and Auditory Discrimination Tests." Journal of Speech and Hearing Disorders 26 (November, 1961): 342-47.

Goldman, Ronald; Fristoe, Macalyne; and Woodcock, Richard. Goldman-Fristoe-Woodcock Test of Auditory Discrimination. Circle Pines, Minnesota: American Guidance Service, 1970.

Griffith, J., and Miner, L. E. "Phonetic Context Approach to Articulation Therapy." Paper presented at the Illinois Speech and Hearing Association Convention, Arlington Heights, Illinois, 31 March, 1971.

Kronvall, E., and Diehl, C. "The Relationship of Auditory Discrimination to Articulation Defects of Children with no Known Organic Impairment." Journal of Speech and Hearing Disorders 19 (September, 1954): 335-38.

Locke, John. "Children's Acquisition of Phoneme Behavior: The Stimulus Versus the Response Side." Paper delivered to the Conference on Symbolic Processes at the University of Akron, Akron, Ohio, 1970.

McDonald, E. T. A Deep Test of Articulation. Pittsburgh: Stanwix House, 1964.

Powers, M. H. "Functional Disorders of Articulation: Symptomatology and Etiology." Handbook of Speech Pathology and Audiology. Edited by Lee Edward Travis. New York: Appleton-Century-Crofts, 1971.

Powers, M. H. "Clinical and Educational Procedures in Functional Disorders of Articulation." Handbook of Speech Pathology and Audiology. Edited by Lee Edward Travis. New York: Appleton-Century-Crofts, 1971.

Romans, E. F., and Milisen, R. "Effect of Latency Between Stimulation and Response on Reproduction of Sounds." Journal of Speech and Hearing Disorders. Monogr. Suppl. 4 (1954): 71-78.

Schiefelbusch, R., and Lindsey, M. "A New Test of Sound Discrimination." Journal of Speech and Hearing Disorders 23 (May, 1958): 153-59.

Schneider, Carole. "Phonetic Context and Articulation Ability." Master's thesis. Eastern Illinois University, 1973.

Sherman, D., and Geith, A. "Speech Sound Discrimination and Articulation Skill." Journal of Speech and Hearing Research 10 (June, 1967): 277-80.

Siegel, Sidney. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill, 1956.

Spriestersbach, D., and Curtis, J. "Misarticulation and Discrimination of Speech Sounds." Quarterly Journal of Speech (December, 1951): 483-91.

Templin, M. "A Study of Sound Discrimination Ability of Elementary School Pupils." 8 (June, 1943): 127-32.

Van Riper, Charles, and Irwin, John. Voice and Articulation. Englewood Cliffs, N. J.: Prentice-Hall, 1958.

Weiner, P. "Auditory Discrimination and Articulation." Journal of Speech and Hearing Disorders 32 (February, 1967): 19-28.

Wepman, J. "Auditory Discrimination, Speech, and Reading." Elementary School Journal 60 (January, 1960): 325-33.

Winitz, H. Articulatory Acquisition and Behavior. New York: Appleton, 1969.

Woolf, G., and Pilberg, R. "A Comparison of Three Tests of Auditory Discrimination and Their Relationship to Performance on a Deep Test of Articulation." Journal of Communication Disorders 3 (January, 1971): 239-49.