RELATIONSHIP OF /r/ ARTICULATORY PROFICIENCY TO SPEECH SOUND DISCRIMINATION

by

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INTRODUCTION AND REVIEW OF LITERATURE

Auditory speech sound discrimination generally refers to the ability to distinguish one speech sound from another (Travis, 1971). It involves a judgment calling for a distinction or comparison among sounds (Kronvall and Diehl, 1954).

Investigators have studied auditory discrimination in relation to specific variables such as age, reading ability, intelligence, and sex. Templin's (1957) research concerning auditory discrimination ability of 3-to-5 year old children and 6-to-8 year old children indicated that sound discrimination ability shows a consistent increase with age; however, its rate of growth is decelerated at about 4.5 to 5 years of age. Although she used a picture discrimination test with the pre-school children and a nonsense-syllable test with the school-aged children, she stated that the results of these tests can be collated. Wepman (1960), Thompson (1963) and Turaids, Wepman and Morency (1972) have also concluded that sound discrimination ability is a function of age. Wepman (1960) hypothesized that the pattern of acquisition of speech sounds might result from the developing process of auditory discrimination, which has usually developed fully by the age of eight. Cohen and Diehl (1963) administered the Templin Speech Sound Discrimination Test to thirty children from elementary grades one, two, and three with 'severe' articulation disorders and to a control group. They found that first grade children had a greater mean number of errors than the third grade children for both the experimental group and the control group. These investigators also concluded that speech sound discrimination improves with maturation.

Wepman (1960) and Thompson (1963) have shown a significant relationship

between poor reading ability and poor speech sound discrimination scores. Auditory discrimination scores appear to have high prognostic value in determining good readers (Thompson, 1963). Flynn and Byrne (1970) found that third grade children with advanced reading abilities scored higher on the Wepman Auditory Discrimination Test, the Templin Speech Sound Discrimination Test, and the Schiefelbusch-Lindsey Test of Auditory Discrimination than third grade children with retarded reading abilities. Christine and Christine (1964) found similar results using first, second, and third grade children as subjects. This study found that children reading at grade level or above scored higher on the Wepman Auditory Discrimination Test than children reading below their grade level.

Travis and Rasmus (1931) found no correlations between scores on a constructed speech sound discrimination task and the Stanford Binet Intelligence scores of elementary school children, while Wepman (1960) found a low positive relation between intelligence scores and speech sound discrimination scores as measured by the Wepman Auditory Discrimination Test (Wepman, 1958). Schlanger and Galanowsky (1966) found that intellectually normal children were superior in speech sound discrimination ability to mentally retarded children of the same mental ages. The tests administered in this study were the Templin Speech Sound Discrimination Test, the Boston University Speech Sound Discrimination Test, the Wepman Auditory Discrimination Test, and a constructed nonsense syllable speech sound discrimination test.

Templin (1957) and Turaids, Wepman, Morency (1972) found no significant difference in speech sound discrimination ability between male and female children.

Extensive investigations of the possible relationship between articulatory ability and general speech sound discrimination ability have produced equivocal

results. Hall (1938) compared functional articulatory speech defectives with a control group of normal speakers using the Travis-Rasmus Speech Sound Discrimination Test and a test involving discrimination of speech sounds in a complex pattern occuring in phrases. The comparison was carried out for two age levels, college freshmen and elementary school children aged seven to thirteen years. This experimenter found no significant differences between speech defective speakers, either at a university freshman or an elementary school age level, and normal speakers in ability to discriminate between simple pairs of speech sounds or to discriminate sounds in a complex auditory pattern. Also, no relationship was found between errors in speech sound discrimination and errors in articulation in that the speech defective group correctly discriminated those sounds they misarticulated.

Hansen (1944) tested 39 college males between the ages of 17 and 24 years on a 50-item vowel discrimination test and a 108-item nonsense syllable discrimination test. The subjects were divided into three groups; untrained functional articulatory defective, functional articulatory defectives who had received articulation therapy, and normal speakers. Results indicated that there were no significant differences among any of the groups for both discrimination tests.

Prins (1963) administered the Wepman Auditory Discrimination Test to 26 children, six years of age, who had articulatory defects and to 19 six-year-old children with normal articulation. The difference in mean errors were not statistically significant. Prins also reported that children who confused the place of articulation during speech sound production also had difficulty discriminating minimal pairs of words where a single phoneme was altered in articulation.

McReynolds, Kohn, and Williams (1975) conducted a study to compare a

child's discrimination of distinctive features and phonemes with the articulation of these phonemes. Seven children between the ages of 3.5 and 7.3 with six or more phonemes in error comprised the experimental group while the control group consisted of seven children between the ages of 5.8 and 8.9 years. The discrimination test consisted of nonsense syllables contrasting minimally on one of six distinctive features. Four same and different arrangements of each phoneme pair were formed. The difference in mean discrimination scores for the experimental group and control group was 10 percent, indicating that the experimental group obtained lower discrimination socres. The mean production score for the experimental group was 37 percent while the mean discrimination score was 84 percent. Therefore, they did not perform equally in both modalities. Through an error phoneme analysis, the authors concluded that the experimental group of children were able to discriminate their error phonemes as well as they discriminated phonemes they could articulate correctly. Another analysis indicated a 39 percent difference between the discrimination socres of correctly produced and incorrectly produced consonants, representing, in the authors' opinion, a minimal difference in speech sound discrimination ability between severely articulatory defective and normal children.

Other research has found that children with functional articulation disorders exhibit significantly more errors in speech sound discrimination than normal speaking children. Travis and Rasmus (1931) compared three age groups of children with mild disorders of articulation with normal speaking children on their ability to discriminate pairs of speech sounds. They compared the speech sound discrimination ability of (1) kindergarten and first grade articulatory defectives with kindergarten and first grade normals,

(2) second and third grade articulatory defectives with second and third grade normals, and (3) fourth and fifth grade articulatory defectives with fourth and fifth grade normals. The sound discrimination test consisted of 366 pairs of speech sounds, 300 consonant pairs and 66 vowel pairs. The subjects indicated whether the pairs of speech sounds were the same or different. At every age level, the children with articulatory defects made significantly more errors than normal speakers. In this same study, Travis and Rasmus found similar results with adult speakers. The sixty-two speech defective college-aged adults made significantly more errors on the discrimination test than the 223 normal speaking adults.

Kronvall and Diehl (1954) matched thirty elementary grade children who misarticulated four or more speech sounds with thirty normal speaking children on the basis of age, sex, grade, and intelligence. The Templin Speech Sound Discrimination Test was administered to all subjects. The difference between the mean discrimination errors for the two groups were significant at the .001 level of significance suggesting that the articulatory defective children exhibited more errors on the discrimination test than a control group of normal speaking children.

Schiefelbusch and Lindsey (1958) compared 24 first and second grade children with a mean of 11.6 articulation errors (determined by a 30-item articulation test) on their ability to discriminate functional speech units (1) as they hear them from others, (2) as they produce them, and (3) as they evaluate them silently. The child's responses were tested in relation to discrimination of rhyming words, initial consonants, and final consonants. Thirty picture cards were used for each discrimination task. Each picture card contained three pictures, two 'alike' items in regard to rhyming,

initial sound, or final sound and one foil. For the first experimental condition, the examiner named the pictures and the child selected the two pictures that "sounded alike". In the second condition, the child named the pictures aloud. For the third condition, the child silently selected the pair that was 'alike'. The results indicated that statistically significant differences existed between the speech defective children and normal speaking children in relation to speech sound discrimination ability, favoring the normal speakers. The speech defective group was judged to produce more errors in the rhyming category, the initial consonant category, and the final consonant category than the normal speaking group.

Farquhar (1961) reported from a study of 50 kindergarten children with 'mild' misarticulations and 50 kindergarten children with 'severe' misarticulations that auditory discrimination tests did not appear to have a prognostic value for self correction. However, the children in the 'severe' articulatory group exhibited significantly inferior ability in discriminating the correct form of a misarticulated sound than children with the 'mild' articulatory defects. For the discrimination tasks used in this study, the examiner presented various phonemes in isolation and the subjects clapped their hands when they heard the stimulus sound.

Cohen and Diehl (1963) administered the Templin Speech Sound Discrimination Test to 30 first, second, and third grade children with severe articulation problems and a control group of articulatory proficient children. They reported that the mean number of speech sound discrimination errors was significantly different between the two groups. The experimental group was found to make more errors on the discrimination test than the control group.

In a study by Marquardt and Saxman (1972), 30 kindergarten children with articulation defects were compared with 30 articulatory proficient

children of the same age on the task of discriminating word pairs that differ by one phonemic element. A significantly greater number of errors was found for the articulatory defective group than for the children with no articulation errors. The results also indicated a tendency for the children with the greater number of articulation errors to make correspondingly greater number of errors on the auditory discrimination task.

The general format of the research reported above has been to administer speech sound discrimination tests measuring a general discrimination ability to articulatory defective children and a matched control group of normal speaking children, resulting in the speech defective children producing significantly more errors on the speech sound discrimination tests than the normal speakers. Sherman and Geith (1967) chose their experimental group on the basis of speech sound discrimination scores rather than articulatory skill. The Templin Speech Sound Discrimination Test was administered to 529 kindergarten children. The 18 children with the highest discrimination scores and the 18 children with the lowest discrimination scores were administered the Templin-Darley Test of Articulation. Children with the higher discrimination scores were significantly superior in articulatory production ability.

Several studies have been conducted to assess the ability of a speech defective child to discriminate the sounds he misarticulates (Spriestersbach and Curtis, 1951; Aungst and Frick, 1964; Wolfe and Irwin, 1973; Monnin and Huntington, 1974). These experimenters hypothesized that the speech defective child has a specific auditory discrimination deficiency rather than a general deficiency in discrimination. The investigations of the ability of children with articulation defects to discriminate their own speech errors have generally supported the belief that children with articulation errors are inferior to

normal speakers in the ability to make discriminatory judgments about speech if the material presented to them consists of their own articulatory errors.

Spriestersbach and Curtis (1951) reported a study conducted by Patricia Anderson in which she investigated the ability of a subject to discriminate between correctly produced sounds and his own type of error productions in the particular contexts in which his errors occurred. Anderson tested 31 children from kindergarten through the fourth grade who were judged to have functionally defective /s/ articulation. A picture articulation test was administered in which the /s/ phoneme was tested in 58 contexts. Using the same set of words in the articulation test, a speech sound discrimination task was designed. The experimenter pronounced a word three times, in one instance producing the /s/ phoneme incorrectly. The results indicated that the subjects made discrimination errors about one-third as frequently as they made articulation errors. She found that discrimination errors occurred in some phonetic contexts in which the subject did not misarticulate the /s/ sound. A significant difference was found to exist in the ability of these subjects as a group to identify the /s/ discrimination errors in contexts in which they misarticulated the /s/ and the /s/ discrimination errors in the contexts in which they had no articulation difficulty, more errors being made in the former condition.

Aungst and Frick (1964) investigated the relationship between the production and discrimination of the /r/ phoneme. Children eight years or older, who misarticulated the /r/ phoneme were studied. The 27 selected subjects were first given the Templin Speech Sound Discrimination Test which requires the subject to respond "same" or "different" to each of 50 pairs of externally produced nonsense words which treats various speech phonemes. A mean score of 45 correct items was obtained on this general test of discrimination ability. The /r/ section of the McDonald "Deep Test" of Articulation was also administered.

The group obtained a mean of 27 correct on this test of articulation production. The experimenters constructed three specific tests of discrimination for the /r/ phoneme to measure the ability of the subjects to judge their own speech production when (1) compared to the production of another speaker, (2) heard on a tape recording at a delayed time, and (3) immediately after producing an /r/ word. Thirty monosyllabic words each containing the /r/ in different phonetic contexts were used for each of these three tasks. The judgment required from the subject after each production was "right" or "wrong", referring to the correctness of their production of the word. The correctness of the subjects' judgments was scored independently by the experimenters. The mean errors in self-judgments made by the subjects were as follows: (1) comparison with another speaker, 18.1 errors; (2) delayed judgments, 19.0 errors; and (3) instantaneous judgment, 19.6 errors. Correlations between the McDonald "Deep Test" of articulation production and each of the three discrimination tasks were significant at the .01 level of confidence.

Wolfe and Irwin (1973) reported a study of specific discrimination ability of school age children. Unlike the previous two reports of specific discrimination ability, these experimenters required same/different judgments rather than "right" or "wrong" judgments. The subjects were 20 first through third grade children and 20 fourth through sixth grade children who misarticulated the /r/ phoneme. Words containing the /r/ phoneme were spontaneously elicited by pictures, carrier phrases, etc. Elicitation was immediately followed by playing a taped recording of the same word produced by a normal speaker. The subjects were then asked for their judgments of whether the productions were the same or different. The experimenters recorded the accuracy of each subject's judgments. Follwing a time lapse of two weeks, the subjects listened

to their previously produced words which were immediately followed by the same word spoken by a normal speaker. Again, same/different judgments were made by the subjects and the judged accuracy recorded. The results indicated that these groups of children were significantly (at .01 level of confidence) less proficient in making same/different judgments when they produced the /r/ words and immediately compared it to a model than when they were able to listen to a recording of their production followed by a model. Grade level did not appear to be a variable of measureable significance.

Monnin and Huntington (1974) compared 15 kindergarten children who misarticulated the /r/ phoneme with 15 kindergarten children (mean age of 6.0 years) having normal articulation to determine if the speech defective children differed from the normal speaking children on the number of errors they produced on a speech identification test. The speech identification test involved the speech sounds the children misarticulated and sounds the children correctly articulated. The examiners also included a group composed of 15 superior speakers twelve months younger than the subjects in the other two groups. The speech sound identification task was divided into four tests. Test 1 consisted of four word pairs contrasting the /r/ and /w/ phonemes. The initial consonant of each of the word pairs in Test 2 differed from the other by only one 'articulatory parameter' and were considered 'acoustically similar'. Articulatory parameters included nasalization, frication, duration, and place. Test 3 was composed of contrastive consonants differing on two or more parameters. These word pairs were considered 'acoustically dissimilar'. In Test 4, the vowels were contrasted in CVC word pairs. Tongue height of the vowels remained constant while front vowels were paired with back vowels. The stimulus items were recorded on tape by an adult female speaker and were

presented on a continuum which ranged from no signal distortion to maximum distortion. The consonant contrasts were distorted by center clipping, whereas the vowel contrasts were subjected to high-pass filtering. Each consonant pair was recorded for seven different listening conditions ranging from slight to maximum distortion. Pair-referent pictures of each of the word pair were presented to the child and a pointing response was required. A total of 15 subtests (word pairs) were administered during four listening sessions. One word pair from each test was presented during four listening sessions. The results of Test 1 (/r/-/w/ contrasts) revealed that the experimental group made significantly more errors, beyond .01 level of confidence, in identifying the correct picture than the control group or the developmental group when the speech signal was undistorted. As the distortion became more severe, there were no significant differences in scores among the groups; all subjects responded randomly. Results of Tests 2, 3, and 4 indicated that the performance of the speech defective children was comparable to that of the normal speaking children when the identification judgments involved sounds all the subjects correctly articulated. The results of speech signal distortion indicated that as distortion became more severe, the errors in identification increased for all groups. The authors concluded that the children who misarticulated the /r/ phoneme did not have a general deficiency in speech sound identification, but a deficiency only for the stimuli containing the /r/ phoneme.

Unlike the equivocal results reported by the various investigators of the relationship between general speech sound discrimination ability and articulation proficiency, the data reported by the investigators of the relationship between discrimination ability of a specific phoneme and the proficiency of producing the phoneme appear to exhibit some rationality.

The data reported by Spriestersbach and Curtis (1951) suggest that a child who misarticulates a specific sound may show errors in his judgment of the adequacy of his perception of that sound and not exhibit a similar perceptual deficit with other phonemes. The study by Aungst and Frick (1964) tends to suggest that the extent of articulation proficiency of a specific phoneme is related to proficiency in discrimination ability or the perception of that phoneme. Further, when utilizing a "right" and "wrong" response as an indicator of discrimination the differences in types of listening or speech sound discrimination tasks appear to be minimal. The research by Wolfe and Irwin (1973) tends to suggest that when the speech sound discrimination response is same/different and a time delay is imposed, differences in discrimination ability are observed among children who have misarticulations. The study by Monnin and Huntington (1974) indicates that kindergarten children and younger children who possess intact articulation proficiency do not make as many speech sound discrimination errors as are made by kindergarten children who possess a specific deficit in articulation proficiency.

Purpose

The general purpose of this research was to extend the body of literature related to specific speech sound discrimination and articulation proficiency. The first objective was to extend the findings of Monnin and Huntington's study by replicating the study with a similar age group and by comparing an older group of articulatory deficient children to a matched normal group on a constructed test of specific speech sound discrimination which was administered by two different methods. A second objective was to determine whether Wolfe and Irwin's observed differences in discrimination responses

could be replicated by a similar but different method. A third objective was to study further the conclusion by Aungst and Frick that a general speech sound discrimination ability (Templin Test) did not relate to specific speech sound discrimination. Specifically this third objective was to determine whether the Wepman Test of Auditory Discrimination (Wepman, 1973) statistically differentiates between normal and articulatory defective children. This is essentially a replication of part of the Prins (1963) findings. It should be recalled that a number of other investigators (Kronvall and Diehl, 1954; Schiefelbusch and Lindsey, 1958; Cohen and Diehl, 1963) have observed differences between articulatory deficient children and normal controls.

METHOD

Subjects

Subjects selected for this study were kindergarten and early elementary age children. Forty subjects were divided into four groups according to grade placement and articulation proficiency. The Developmental Articulation Test (Sanders, 1972) was administered individually to each child and the responses recorded by a trained graduate student in speech pathology skilled in the administration and scoring of articulation tests.

Control Groups. The kindergarten control group was composed of 10 normal speaking children, five girls and five boys, with a mean age of 70.8 months and a standard deviation of 2.52 months. The early elementary group was also composed of 10 normal speaking children, five girls and five boys, with a mean age of 84.9 months and a standard deviation of 5.45 months. The criterion for inclusion in these groups was that the subjects display correct articulation production for all sounds tested in all positions.

Experimental Groups. The kindergarten experimental group was composed of 10 children, five girls and five boys, with a mean age of 70.8 months and a standard deviation of 2.52 months. The early elementary group was composed of 10 children, five girls and five boys, with a mean age of 83.2 months and a standard deviation of 5.92 months. All subjects in both experimental groups misarticulated the /r/ phoneme in the initial, medial, and final positions. According to Templin's (1957) study over 85 percent of all five-year-old children and 90 percent of all six-year-old children correctly articulate the /r/ in all positions. An articulation error on the /r/, therefore, would minimally indicate that the subject was in the bottom 25 percent of his age

group for mastering this sound. If a sound was misarticulated in one position, then it was counted as one error. Therefore the minimum number of errors for any subject in this group was three. Some subjects misarticulated other consonant sounds in addition to /r/. For the kindergarten group the mean number of misarticulations was 6.9 with a standard deviation of 5.21. For the early elementary group the mean number of misarticulations was 6.0 with a standard deviation of 3.29. None of these subjects had participated in speech or language intervention programs before their inclusion in this study.

Criteria for Subject Eligibility. Each child had normal hearing as measured by a pure-tone audiometric screening test at the frequencies of .5K, 1K, 2K, 4K, and 6K Hz at 25dB, HTL. To ascertain that the groups had at least normal ability in receptive vocabulary, the Peabody Picture Vocabulary Test was administered to each child. The criterion established specified that each child must obtain a percentile score of at least 30. All subjects met these eligibility criteria.

Subjects were selected from public schools located in a rural part of Northeastern Kansas. All subjects were free of any known organic involvements which might contribute to impairment of articulation proficiency.

Stimuli

An objective of this study was to compare the ability of children to evaluate speech on two tasks of speech sound discrimination of /r/. On Task I the subject listened to pairs of words spoken live-voice by the experimenter and then judged whether the two words were "same" or "different". On Task II the subject heard an /r/ word spoken by the experimenter, produced the word himself, and then judged whether his production was the "same" or "different" as that spoken by the experimenter.

The stimuli for Task I consisted of 30 pairs of words. Of the 30 pairs of words, in one-half or 15, the two words in the pair were identical. Of these 15 words, the /r/ appeared in the initial, medial, and final position with equal frequency. The words selected for the pairs were as follows:

Initial	Medial	Final
rung	curtain	bar
rich	[illegible]rning	snore
ring	largest	air
raise	horses	were
rear	forbid	far

For the 15 pairs of words in which the foil was a non-/r/ word the experimenter prepared a list of 100 pairs of words, one of which contained the /r/ and another word which sounded similar to the word containing the /r/ but excluded that sound. This list was widowed to 15 pairs of words, with the /r/ word pairs appearing five times in the initial, medial, and final position. The widowing procedure entailed submitting the list of 100 pairs to five trained speech pathologists with the instruction that each individual mark the pairs which they considered to be a difficult speech sound discrimination. The word pairs which were most frequently marked as difficult were selected for inclusion in Task I. Each pair included in the task received difficult judgments by three out of the participating speech pathologists. The selected word pairs were as follows:

Initial	Medial	Final
round-wound	skating-scaring	single-singer
roar-your	matching-marching	hanger-hanging
wait-rate	healing-hearing	butter-button
rose-those	firing-filing	eager-eagle
recite-delight	bowing-boring	better-better (eastern/r/)

The stimuli for Task II were the 30 /r/ words contained in Task I. All of the words selected for these two tasks appear in the first

3000 words of the Thorndike and Lorge (1944) list. Randomization within each task was accomplished by writing each item on a slip of paper, scrambling them and then drawing them from a bowl. The order in which the items were drawn from the bowl determined the order of the items on each task. (See Appendix A for the resulting data sheets for the speech sound discrimination Tasks I and II which were derived and used in the study.)

Another objective of this study was to compare the groups of subjects detailed above on a general test of speech sound discrimination. The tool for accomplishing this objective was the Wepman Test of Auditory Discrimination (1973). This test was administered and scored according to the test manual.

Procedure

Data collection for each subject was completed in ten to twenty minutes. Empty resource rooms or classrooms, removed from playground noise, provided the space for testing procedures. The sequence of the procedure was as follows: (1) administration of the Wepman Test of Auditory Discrimination; (2) pre-test for Task I for specific speech sound discrimination; (3) administration of Task I; (4) pre-test for Task II of specific speech sound discrimination; and (5) administration of Task II. The audio data for Task II was recorded on a portable cassette tape recorder. The microphone was placed on the table facing the child. The experimenter sat directly across the table from the subject and concealed her mouth with a 5" x 8" card. Care was exercised to keep the word pairs exactly alike in regard to pitch, intensity, and duration. The examiner attempted to produce the words in a pleasant, normal manner. Eye contact was maintained with the subjects during the experimenter-produced stimuli presentations.

For Task I, a visual pre-test was designed to assess the child's

comprehension of the same/different concept in a modality that was not being tested in the discrimination task. In a study by Turaids, Wepman, and Morency (1972) in which four auditory discrimination and memory tests and two visual discrimination and memory tests were administered to children five to eight years of age, it was found that children below the age six had difficulty understanding the tasks requiring a same/different response. They suggested that children be given training in making the same/different response in the modality not being tested. Five sets of paired pictures, three different pairs and two same pairs, were placed on individual cards (See Appendix B). The pictorial stimulus was presented to the child for two seconds and then removed from the child's view. After a one-second delay, the child was required to determine whether the pictures were the same or different. When the child correctly responded to the five items in this pre-test, Task I was administered. Each subject responded with 100 percent accuracy to this pre-test. The one-second delay before the child's response was incorporated to control for the memory factor associated with stimuli presented through the auditory modality. When presenting auditory stimuli, its occurrence is brief. The child must retain the auditory stimulus in order to respond appropriately. By incorporating the one-second delay after the visual stimulus has been presented, the child is required to maintain a visual image of the stimulus in order to correctly determine whether the pictures were the same or different.

The instructions provided the subjects with Task I were, "I am going to say two words. You tell me if the words sound the same or if they sound different." This was followed by four demonstration items, two of which required a same response and two a different response. The word pairs for

the demonstration items did not contain the /r/. If the subject responded incorrectly to a demonstration item he was corrected and the item repeated. The experimenter then proceeded to administer Task I.

Following the rationale advanced for the pre-test for Task I, a pre-test for Task II was also designed and administered using the visual modality. Four geometric figures (zero, square, cross and an X) were placed on 3" x 5" cards. The four cards were serially presented to the subject. Each card was presented to the subject for two seconds, the model was then covered, and he was instructed "to copy what you have just seen", on a blank 3" x 5" card. The subject's drawing was then covered and in one second he was asked if his "drawing was the same or different than the one he had just seen." Accuracy of the subjects' judgments was 97 percent correct for all groups.

For Task II the instructions were, "I am going to say a word and I want you to say the same word. Then I want you to decide if we said the word in the same way or differently." Four demonstration words (cat, dog, mouse, table) were then presented with correction and repetition of the demonstration item when appropriate. The experimenter then proceeded to administer Task II.

Analysis of Responses

For the Wepman Test of Auditory Discrimination, each "same/different" response was scored as correct (+) or incorrect (-). The total number of items scored as correct was used by group for statistical analysis.

Task I, which is similar to Wepman's test except for it's focus on the /r/ phoneme, was scored in the same manner, i.e., the "same/different" responses were scored as correct or incorrect. For statistical analysis the total number of responses scored incorrect was used for each subject.

For Task II, the experimenter was required to make judgments of whether

the subject's production was a reasonable approximation of the word just spoken (normal articulation or misarticulation) and then record if the subject's judgment was in agreement with the experimenter's. Agreement could exist under two conditions. Both the subject and the experimenter could agree that both word productions were correctly articulated. And secondly, both could agree that both word productions did not match. Likewise, disagreement could occur under two conditions. The production of the experimenter and the subject did not match, and the subject stated the two productions were the same. Or the productions of the experimenter and subject did match and the subject stated the two productions were different. The vast majority of disagreements were of the first type. Agreements were scored as correct responses and disagreements were scored as errors. The total errors for each subject by group were used for statistical analysis. To determine the experimenter reliability, another trained graduate student in speech pathology randomly selected recordings of 12 of the subjects and made an independent evaluation from the taped records of the experimenter's scoring. The two judges were in agreement on 323 of 360 opportunities. Using the reliability index of agreements divided by agreements plus disagreements, a reliability index of .90 was obtained.

Statistical analysis employed t-test procedures to determine significance of mean differences between the articulation proficient groups and the /r/ articulation deficient groups. t-test procedures were also used to determine the significance of mean differences by age level, i.e., grade placement.

RESULTS AND DISCUSSION

The general purpose of this study was to extend the literature concerning the relationship between specific speech sound discrimination proficiency and articulatory proficiency. Monnin and Huntington (1974) reported that a group of /r/ articulatory deficient children scored significantly lower on a speech sound identification task contrasting initial /r/ and /w/ words than a group of matched children with normal articulation. An objective of this study was to attempt to replicate the Monnin and Huntington finding utilizing pairs of /r/ words which required a same/different response rather than pointing to the correct word pictured. For the kindergarten groups on Task I, where two externally produced words were compared, a mean of 2.60 errors was observed for the articulatory deficient children and a mean of 0.10 errors was observed for the matched control group. t-test statistical analysis yielded a t-ratio of 8.90 which is significant beyond the .01 level of confidence. Comparing the kindergarten groups for Task II, where externally produced words are compared with self produced words, a mean of 27.30 errors was observed compared to 0.10 errors for the control group. The t-ratio in this comparison was 21.08 which is significant beyond .01 level of confidence. Since Monnin and Huntington's study was restricted to kindergarten-aged children, their findings for their constructed identification task appear to be confirmed and extended to discrimination tasks herein employed.

A further specific objective of this study was to determine whether the Tasks I and II constructed for this study discriminated between the early elementary group of /r/ articulatory deficient children when compared to the normal control group. For Task I with early elementary aged children,

Table 1

Comparison of Mean Number of Speech Sound Discrimination Errors and Standard Deviations for /r/ Articulatory Deficient Children with a Control Group

Group	Grade Placement	
	Kindergarten	Early Elementary
	Task I - Comparing two externally produced words	
Articulatory Deficient		
Mean	2.60	0.60
S.D.	1.56	0.92
Control Group		
Mean	0.10	0.10
S.D.	0.30	0.30
	Task II - Comparing externally produced to self produced words	
Articulatory Deficient		
Mean	27.30	26.60
S.D.	3.87	3.10
Control Group		
Mean	0.10	0.10
S.D.	0.30	0.30

Note. Maximum correct on both tasks = 30.

a mean of 0.60 errors was observed compared to a mean of 0.10 errors for the control group. This t-ratio of 1.52 failed to significantly differentiate these groups at the .05 level of confidence. However, comparison of the kindergarten and early elementary aged group with their respective control groups on Task II yielded t-ratios of 21.08 and 25.73 respectively. Both of these t-ratios are significant beyond the .01 level of confidence. In summary, Task II of the present study appears to yield pronounced differences in error rate between the articulatory deficient group and the normal group independent of age level. The observed differences on Task I, while significant with the kindergarten group, were not significant with the early elementary group.

It may be argued that the identification task involves comparison of external stimuli to a phoneme related memory system, whereas same/different response to two externally produced stimuli does not contain this possible memory element. However, it could be that the identification task is more closely related to Task I of the present study than Task II inasmuch as comparison of externally produced stimuli to self produced stimuli is not involved in the identification process. The question as to whether a specific speech sound identification task like that employed by Monnin and Huntington will discriminate between older articulatory deficient children and normal children should be answered by further research.

A second objective of this research was to partially replicate and extend the findings of Wolfe and Irwin (1973) concerning speech sound discrimination with children who misarticulate the /r/ phoneme. The present early elementary group overlaps in age with a group studied by Wolfe and Irwin. The present study also includes a younger age group. Their basic

finding was that children more readily discriminated articulation errors when both members of the pair to be judged were emitted by an external source than when one of the sources was provided by self production. The Wolfe and Irwin study concerned itself with articulatory deficient children only. The present study also included a control group of normal articulating children. It can be seen from inspection of Table 1 and reference to the previous statistical analysis that: (1) the normal articulating children or control group do not exhibit measurable differences by task nor age level; (2) comparison of the early elementary age groups by Task I and II confirm the Wolfe and Irwin previously recorded findings for a similar age group; and (3) comparison of the articulatory deficient kindergarten group on Task I and II may be considered an extension of the previous authors' findings to a younger age group. In summary, the results of the present research confirm those reported by Wolfe and Irwin for articulatory deficient children and provide evidence that the phenomenon also appears to be a variable with kindergarten-aged articulatory deficient children. The phenomenon does not appear to be evident in normal articulating children.

A third objective of this research was to study general speech sound discrimination as a function of (1) deficient vs. normal articulation, and (2) age or grade level. Aungst and Frick (1964) concluded that general speech sound discrimination did not relate to specific speech sound discrimination using the Templin Test with other measures. Prins (1963) reported failure to find significant differences between normal and articulatory deficient children using the first edition of the Wepman Test of Auditory Discrimination. The present study utilized the 1973 revision of the Wepman Test. Table 2 shows the means and standard deviations for the four groups of children included in

Table 2

Comparison of Mean Number of Correct Auditory Discrimination Responses and Standard Deviations for /r/ Articulatory Deficient Children with a Control Group as Measured by the Wepman Test of Auditory Discrimination

Group	Grade Placement	
	Kindergarten	Early Elementary
Articulatory Deficient		
Mean	27.70	28.60
S.D.	1.10	0.92
Control Group		
Mean	27.30	29.3
S.D.	0.90	2.74

Note. Maximum correct on Wepman Test = 30.

the present study. No statistically significant differences were obtained between either articulatory deficient groups and their respective control groups. A trend significant at the .10 level of confidence was found between the kindergarten and early elementary groups for both articulatory deficient and control groups, suggesting that this test instrument may not be, at least with the groups studied, a tool of critical importance.

General Discussion.

The principle finding of the present research was, for the articulatory deficient groups, the magnitude of the mean differences in speech sound discrimination for /r/ between their error rate on a task which involved comparing two externally produced words (less than one percent errors for kindergarten group) and their error rate when comparing externally produced words to self-produced words (80 to 90 percent error rate). Should replication of this research with the /r/ and other phonemes obtain similar findings, it may indicate that substantially more data should be accrued in the area of specific speech sound discrimination for articulatory deficient children.

Some traditional articulatory treatment procedures have concentrated on sound discrimination activities, but the extent to which these treatment programs have directed specific training to self-monitoring tasks is not clear. Further, it is questionable from the present research if general speech sound discrimination plays a significant role in the evaluation process for an articulatory deficient child. While it has been demonstrated that general speech sound discrimination tests related to other attributes of children, their relationship to articulation proficiency is not impressive.

As was indicated previously the findings of the present research generally support other studies which have been concerned with specific

speech sound discrimination. The observed differences between older children on identification speech sound tasks (Monnin and Huntington) and the present study have been previously discussed. Research concerned with comparison of identification tasks and those employed in the present study may be informative in providing greater understanding about the relationship between sound discrimination tasks and articulation proficiency.

Specifically, subsequent replication should counterbalance between the tasks herein employed. While it is doubtful that fatigue or other variables which may relate to serial presentation was operative to a measurable degree in the present study, total data collection time was only 15 minutes. The possibility of the serial variables should not be ignored.

The relationship of specific speech sound discrimination and articulation proficiency, especially in the self-monitoring modes appears to be viable research areas worthy of further study.

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APPENDIX A

The following data sheets were used for scoring the subjects' responses for Task I and II of the constructed specific speech sound discrimination test.

TASK I

Examiner produces both words asking for a same/different response from the client.

	S	D		S	D
1. curtain-curtain (kɝtən-kɝtən)			16. healing-hearing (hilɪŋ-hɪrɪŋ)		
2. round-wound (ravnd-wavnd)			17. firing-filing (faɪrɪŋ-faɪlɪŋ)		
3. single-singer (sɪŋgl̩-sɪŋɚ)			18. largest-largest (lɑrdʒəst-lɑrdʒəst)		
4. roar-your (ror-jor)			19. rear-rear (rɪr-rɪr)		
5. bar-bar (bar-bar)			20. snore-snore (snor-snor)		
6. skating-scaring (sketɪŋ-skɛrɪŋ)			21. horses-horses (hɔrsɪz-hɔrsɪz)		
7. wait-rate (wet-ret)			22. raise-raise (rez-rez)		
8. matching-marching (mætʃɪŋ -mɑrtʃɪŋ)			23. better-better (bɛtə-bɛtɚ)		
9. rung-rung (rʌŋ-rʌŋ)			24. air-air (ɛr-ɛr)		
10. rich-rich (rɪtʃ-rɪtʃ)			25. were-were (wɝ-wɝ)		
11. ring-ring (rɪŋ-rɪŋ)			26. eager-eagle (igɚ-igl̩)		
12. rose-those (roz-ðoz)			27. recite-delight (rɪsaɪt-dɪlaɪt)		
13. hanger-hanging (hæŋɚ-hæŋɪŋ)			28. far-far (fɑr-fɑr)		
14. butter-button (bʌtɚ-bʌtn̩)			29. forbid-forbid (fɚbɪd-fɚbɪd)		
15. morning-morning (mɔrnɪŋ-mɔrnɪŋ)			30. bowing-boring (baʊɪŋ-borɪŋ)		

TOTAL _____

TASK II

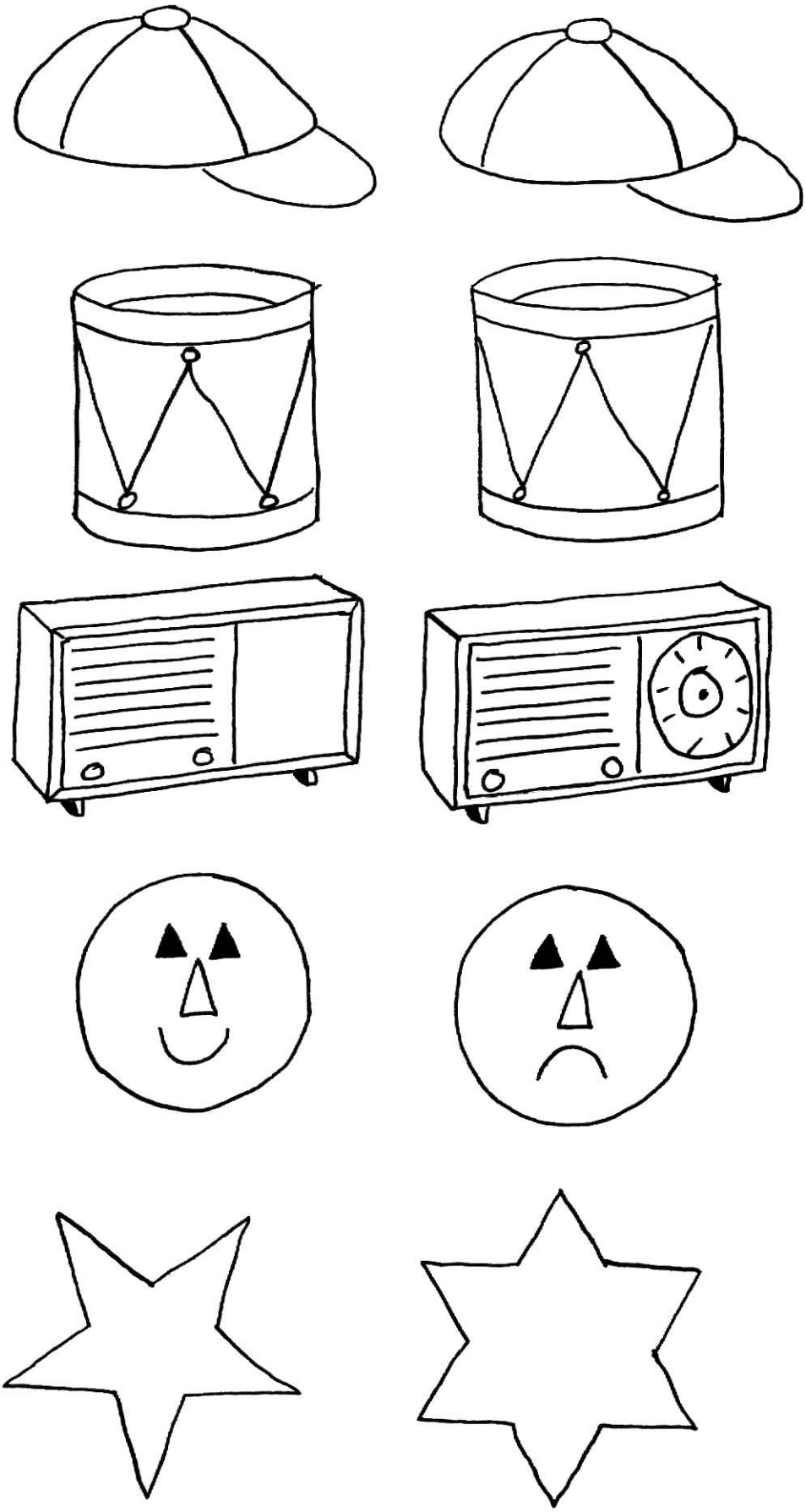
Examiner says the word and asks the client to repeat the word. Client judges whether his production was the same as or different from the examiner's production of the word.

	S	D		S	D
1. curtain (kɝtən)			16. hearing (hɪrɪŋ)		
2. round (raʊnd)			17. firing (faɪrɪŋ)		
3. singer (sɪŋɚ)			18. largest (lɑrdʒɪst)		
4. roar (ror)			19. rear (rɪr)		
5. bar (bɑr)			20. snore (snor)		
6. scaring (skɛrɪŋ)			21. horses (hɔrsɪz)		
7. rate (ret)			22. raise (rez)		
8. marching (mɑrtʃɪŋ)			23. better (bɛtɚ)		
9. rung (rʌŋ)			24. air (ɛr)		
10. rich (rɪtʃ)			25. were (wɝ)		
11. ring (rɪŋ)			26. eager (igɚ)		
12. rose (roz)			27. recite (rɪsaɪt)		
13. hanger (hæŋɚ)			28. far (fɑr)		
14. butter (bʌtɚ)			29. forbid (fɚbɪd)		
15. morning (mɔrnɪŋ)			30. boring (borɪŋ)		

TOTAL _____

APPENDIX B

The following pairs of pictures were used as the stimulus items for the pre-test for Task I of the constructed speech sound discrimination test.



RELATIONSHIP OF /r/ ARTICULATORY PROFICIENCY TO SPEECH SOUND DISCRIMINATION

by

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The purpose of this research was to study specific speech sound discrimination of the /r/ phoneme in relation to articulation proficiency of the /r/ phoneme.

Forty kindergarten and early elementary age children were divided into four groups of ten each according to articulation proficiency and school placement. Two specific tests of /r/ speech sound discrimination were constructed and individually administered to the members of these four groups. These specific discrimination tasks included a same/different judgment of two externally produced words and a same/different judgment of an external production and a self production. Also, a commercially available test of auditory discrimination was administered to each subject. The results suggest that the constructed specific speech sound discrimination task that compared an external production to a self production significantly discriminated between the articulatory deficient and the normal control groups at both the kindergarten and early elementary age levels. The other specific speech sound discrimination task comparing two externally produced words discriminated between the articulatory deficient groups and the control groups at the kindergarten level. The commercial test of auditory discrimination ability failed to discriminate between groups selected by articulation proficiency or age level.

The resulting findings were discussed in relation to other related research reported and proposed implication for articulation evaluation and treatment and possible areas for further research.