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An Investigation of Certain Factors Influencing the Testing of Auditory Phonetic Discrimination

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AN INVESTIGATION OF CERTAIN FACTORS INFLUENCING THE TESTING OF AUDITORY PHONETIC DISCRIMINATION

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CHAPTER I

THE BACKGROUND OF THE PROBLEM

Review of the Literature

The importance of auditory phonetic discrimination in speech therapy. One of the basic criteria for good articulation is that the individual sounds or phonetic units which make up a word must be produced correctly and arranged properly in sequence. According to Van Riper (32:127), when a speaker adds, omits or distorts a particular phoneme to the extent that it alters word meaning, calls attention to itself, and/or produces unpleasant emotional reactions in the speaker or audience, he is adjudged to have an articulation defect.

Among the first steps in training the child defective in articulation is to teach him to recognize his error. One of the essential processes involved here is auditory phonetic discrimination. Johnson (16: 38) defines phonetic discrimination as "the ability to hear differences between speech sounds." Van Riper (32: 175) defines it as "... hearing the difference between two sounds and recognizing the contrasts involved." Ainsworth (1: 60) considers this ability as hearing the differences between two sounds and being able to tell which one is correct. For the purposes of this study, auditory phonetic discrimination ability is the capacity for hearing two sounds as "alike" or "different".

Several authors have indicated the importance of developing this ability early in the therapeutic process. Ainsworth (1: 60) lists the first principle for correcting articulation defects as "making the child aware of the differences." West, Kennedy and Carr (33:301) show the importance of sound discrimination in therapy when they say that "ear training, however, is required by the great majority of cases ..."

Van Riper (32: 159), also, believes that this training is indicated in the majority of cases. He says, "through intensive ear training, the old word configurations are broken down so that the correct sound and the error can be isolated, recognized, identified, and discriminated." Nemoy and Davis (22:36) describe this ability as one of having a correct mental picture of the sound before it can be produced properly. Irwin (15: 206) and Johnson (17: 430) indicate the additional importance of this part of therapy by including tests of discrimination in their respective textbooks. Mase (20: 68) concludes from his study of the etiology of speech defects that "auditory phonetic discrimination tests should be a routine part of the examination in speech clinics before recommended speech therapies are prescribed."

Since as evidenced above, phonetic discrimination training is so widely recommended and used, it seems desirable that the speech therapist know as much as possible about it.

Previous research into the problem of phonetic discrimination ability. In order to gain insight into the phonetic discrimination ability of speech defective children, several experimenters have raised questions concerning this ability and have constructed tests to answer them. In 1946, Mase (20) tried to discover if there were any differences in discrimination ability between speech defective children and their normal speaking controls when compared on a test in which they responded alike or different to two words which were either alike or different in only one sound. He double checked this ability by presenting sentences in which there were either no errors or only one error, the error consisting of a word mispronounced by only one sound. He found that for the 53 fifth and sixth-grade boys tested, there were no significant differences between normal speaking controls and speech defectives in discrimination on either of these tests. In 1938, Hall (12) reported that neither university freshmen nor elementary school children with functional articulatory speech defects were deficient in phonetic discrimination to a greater extent than their normal speaking controls.

Carrell (6) studies this same problem in 61 speech defective children who were matched with controls in terms of age, sex, and intelligence. He found that the children with speech defects, as a group, were inferior to their controls in speech sound discrimination. Yet many of the controls made errors similar to the speech defectives when considered individually. Travis and Rasmus (31) tested 548 subjects who ranged from five years of age to adulthood. The test consisted of 366 pairs of speech sounds. At all age levels, the speech defectives made significantly more errors than the normal speakers. Donewald (7) constructed a test of phonetic discrimination ability in which the subjects compared the correct phoneme with their own most characteristic error. He reported that this test differentiated between speech defectives and normal speaking controls.

Mase, in the research cited above, found no relationship between the severity of the articulatory defect and the discrimination ability of the child. Yet, Carrell's research (6) found that twenty children tested as having only one or two articulatory errors were not significantly inferior to their controls in discrimination, while forty children having three or more articulatory errors were significantly inferior to their controls in phonetic discrimination ability.

Pronvost and Dumbleton (23) constructed a picture test of speech sound discrimination ability in which more than 100 children were shown pictures representing the words which were phonetically alike except for one sound. The experimenter would say the words and the subject would point to the appropriate picture for his response. According to their figures, ten per cent of the first grade population tested were deficient in discrimination ability. The test used was modeled after the Mansur which was an outgrowth of the Travis-Rasmus as described in the article.

Anderson (2) tried to delineate the problem further by examining his results in terms of the type of articulation errors seen in the child tested. He found that there was a statistically significant relationship between omission type errors and poor discrimination ability but that the relationship did not hold for distortion and substitution type errors.

Schlanger (24) tested the discrimination ability of feebleminded children before and after speech therapy. He found no significant change in their scores after therapy.

Summary. Briefly stated, some of the questions which have been raised about phonetic discrimination are these:

(1) Do speech defective children differ from normal speakers in this ability?

(2) Does intelligence influence discrimination ability?

(3) Is age related to one's ability to discriminate?

(4) Is the severity of the articulatory defect related to the discrimination ability of the case?

(5) Is the type of articulatory error (omission, distortion, or substitution) related to this discrimination ability?

(6) Does therapy improve discrimination ability?

As indicated on the preceding pages, there is a considerable conflict among the findings of the studies designed to answer these questions. The only justifiable conclusion is that some experimenters have found some children to be deficient on some types of discrimination tests, while some experimenters have not.

When the inconsistencies in the above data are considered in relation to the emphasis on this skill during therapy, there is some question about either the content and rationale of ear training therapy or the nature of the tests used to explore phonetic discrimination ability.

The validity of current tests of phonetic discrimination. In many investigations of discrimination ability, authors have concluded that certain factors were operating in their tests to alter results. Templin (28) revised and shortened the Travis-Rasmus test of discrimination and found that it is more difficult to discriminate consonant sounds when they are placed in the medial or final position with respect to the vowel with which they are combined for presentation than in the initial position. This refers to the syllable comparison type test. Linton (19) found that the number of errors on a test of this type depends on the difficulty of the two sounds used, while Tiffany (29) reported that certain vowels ([ʊ], [ɪ], [æ], and [ɝ]) are decidedly more distinctive and recognizable than others ([e], [ʌ], [ɔ], and [i]).

In this same general area, Sherman (25) studied the influence of vowels on the recognition of adjacent consonants and reports "in the main, the results support the general hypothesis that there is a variation in the per cent recognition of a consonant concomitant with variation of the adjacent vowel." Fletcher's data support this point of view when they show that a consonant sound may sometimes be identified by the modification produced on the adjacent vowel even though the consonant is below the threshold of perceptibility.

The conclusion drawn from the work of these experimenters is that an accurate measure of the ability to recognize a specific sound will be difficult to obtain if the test stimulus is presented in combination with another sound. It also suggests that a certain group of sounds taken in comparison with others will be more or less difficult to discriminate than their comparators.

Pronvost and Dumbleton (23) conclude from their study that "greater validity could be obtained if a tape recorded test were used under acoustically controlled conditions."

They noted that one tester found that fifty per cent of the children made no errors on the test. All other testers on the project found that less than five per cent of the children made no errors.

Another challenge to the validity of these former tests is that research into auditory memory span by Metraux (21) found that speech defectives are better able to use their memory span on a test using vowels as stimuli than are normal speakers. These same subjects were tested using consonants for stimuli and it was found that the speech defectives made lower scores on this test than normals. The obvious implication of these data is that tests of discrimination may well be influenced by the time lapse between the presentation of testing stimuli and variations in the use of vowels and consonants as testing stimuli. It should be noted that whether or not a speech defective differs from a normal speaker on a test of auditory memory span, one child will differ from another as seen in the distribution of scores on any test of this ability.

There is another criticism of these existing phonetic discrimination tests which be altering their results and causing confusion when the results of two tests are compared. Whereas one refers to discrimination as if it were only one ability, experimenters may really be testing several different discrimination abilities and trying to compare them with each other. This means that a child's ability to tell the difference between two isolated sounds (f-v) may be different from his ability to discriminate between two nonsense syllables (si - zi) and these may both be different from his ability to discriminate between words (ring - wing). It is also important that the test may be influencing the results of discrimination tests in that after a certain time fatigue may affect the subject's discrimination ability or interest in the test. Templin (28) demonstrated this fact in a study of the Travis-Rasmus results which indicated that there were significantly more errors on the last half of the test as compared with the first half.

A final factor that may be affecting the practical value of phonetic discrimination tests is that many existing tests ask the child to work with <u>all</u> sounds or other sounds than those involved in his articulation error. Thus, an assumption is made that a general discrimination ability score is indicative of the case's ability to discriminate the specific phonemes he misarticulates. This may or may not be the case.

In brief, some of the factors which have been suggested as possibly influencing the results of discrimination tests are; (1) the position of the sound in context, (2) the per cent recognizability of the sound, (3) variations of stimulus presentation (in terms of time lapse between presentation of stimuli and phonemic production differences in experimenters), (4) auditory memory span, (5) lack of adequate definition of what is being tested, (6) fatigue, and (7) the use of general discrimination stimuli in place of specific error phoneme.

<u>Summary.</u> So far, an investigation of the literature on phonetic discrimination testing has indicated several areas of interest or problems which have been tested through varying methods. However,

as a review of the conflicting results clearly shows, no definite conclusions can be drawn. This has lead to an evaluation of the testing procedure used, with the research indicating that certain factors in the tests themselves may have influenced the available data on phonetic discrimination ability.

Statement of the problem. In view of the conflicting results on phonetic discrimination tests and because of the criticisms of the tests themselves, a question is raised as to whether or not a test which includes these factors would differ significantly from one which minimizes them. The factors or variables referred to are those listed on the preceding pages. More specifically it is suggested by the writer that scores on a test of phonetic discrimination which does not control fatigue, variations in the presentation of stimuli, contextual phoneme influence, per cent recognizability variations, and position of the sound in context will differ significantly from one which minimizes these factors.

As demonstrated later, the Templin test is a test of the first kind and includes all these listed factors, while a test whose construction is described later (called the experimental test) tends to minimize these factors.

Thus, the problem of this study is to compare the scores made by a group of students on both of these tests to determine whether a statistically significant difference appears. This obviously involves the testing of the null hypothesis.

CHAPTER II

METHODS USED IN THE STUDY

Testing methodology. In order to test the hypothesis of this study it was necessary to: (1) select a test of phonetic discrimination which contained all the criticized variables, (2) construct a test of phonetic discrimination which minimized all these variables, (3) administer both tests to the same group of speech defective children, and (4) compare the results statistically.

Selection of the Templin Test. The Templin short form revision of the Travis-Rasmus as represented in Van Riper's Speech Correction - Principles and Methods (32: 137) was selected as the control test because it contained all the seven variables mentioned as possibly influencing the results of phonetic discrimination tests. A copy of the test, consisting of seventy pairs of nonsense syllables is found in Appendix A.

Specifically, the possible weaknesses in a test such as this are as follows: (1) a test of seventy items may be affected by the fatigue of the testee more than a test of fewer items, (2) since the test is not tape recorded, it is possible that the production of sound may vary from item to item and from experimenter to experimenter, (3) even if the time lapse between paired stimuli is consistent, there is some possibility that since the two sounds are not presented simultaneously, differences in the auditory memory span of the testees may alter the results, (4) since this test presents 26 different phonemes for testing, its value as a tool for indicating discrimination ability on the one particular phoneme which the subject is misarticulating is in doubt. For example, only two opportunities are presented for discriminating the [ɝ] sound on this test, yet the results are used as an indicator of the ability to discriminate specific sounds, (5) since the testing stimuli are presented in the context of one or two other sounds, their recognition may be influenced by these others, (6) further, the sounds may be more or less difficult to discriminate than the defective sound the child uses, and (7) since these sounds occur in different positions in a phonetic context which can alter recognition, the Templin Test and others like it are subject to this criticism.

Construction of the experimental test. The second requirement for testing the proposed hypothesis was the construction of a test of phonetic discrimination which minimized the seven factors summarized above. Briefly stated, such a test had to be a short, recorded test of phonetic discrimination in which one isolated phoneme is presented simultaneously with each of the individual isolated sounds frequently substituted for it. Since no one of the existing tests embodied all these characteristics, it was necessary to construct one.

Choosing the stimuli. The first step was locating one phoneme suitable for testing within the requirements of this procedure. Three criteria were met in deciding to use the [ɝ] sound and its three commonly substituted error sounds [ɜ], [ʊ], and [ʌ] as the testing stimuli. First, in order to make the test most practical, it was deemed wise to choose one of the sounds most frequently misarticulated. According to Van Riper (22) these are [s], [r], and [l]. Second, because the test had to be recorded it was necessary to eliminate any of these sounds which are, to some extent, discriminated visually. The [s] was eliminated because its most common substitution is [θ] which is discriminated visually from the [s] by its tongue protrusion. The [s] was also eliminated when it was demonstrated in ten trial recordings that it is extremely difficult to record the auditory difference between these two sounds without high fidelity equipment. Third, since this test demands that the two testing stimuli are presented as simultaneously as possible, it is necessary that the sounds be sustained over a long period of time. This eliminated the [l] because, in its consonant form, part of its production is the downward glide of the tongue with the termination of voicing which, of course, cannot be sustained. It was also found that both the [s] and [l], are too difficult to sustain while holding the pitch and intensity constant as is required here. For these reasons, it was found necessary to use the [r], in its vowel form [ɝ] as the testing stimulus.

Minimizing fatigue. It was decided to compare the [ɝ] with itself [ɝ] and three of its common error substitutions [ɜ], [ʊ], and [ʌ]. Each of these four comparisons was made four times making a total of sixteen judgments on the test. This is about one-fourth the number of judgments on the Templin and requires twenty-five per cent less time to administer. Obviously, this test had to be long enough to assure that each subject attained some score. By presenting the test to ten speech defective adults, it was determined that none approached the maximum possible error of sixteen.

Isolating the individual phenomes. The following procedure was used to obtain sustained and consistent tape recorded samples of the isolated sounds [ɝ], [ɜ], [ɚ], and [ʌ]. First, while listening to a sustained audiometric pure tone set at a comfortable loudness level and at a pitch most nearly like that of the experimenter's voice (560 cps), the experimenter recorded several 15 second samples of a sustained [ɝ] holding the pitch and intensity as constant as possible with that of the audiometric tone. Second, these individual samples were spliced in circles so as to produce a continuous and uninterrupted [ɝ] phenome. Third, the experimenter and two major professors acted as a board of judges to determine the circular tape of the least variation in pitch and intensity. This was called the basal [ɝ]. Fourth, this tape was played continuously through ear phones to the experimenter while he produced several samples, each, of the four phenomenes [ɝ], [ɜ], [ɚ], and [ʌ] to be compared with the basal sound. These four sounds were sustained for ten seconds. Fifth, the sample of each of the four sounds which best maintained an intensity and a pitch equal to the basal [ɝ], and which was most representative of its phonetic symbol was selected. Sixth, these four were spliced into a continuous tape which then contained ten seconds of each of the four testing stimuli.

The rationale for the use of a board of auditors rather than vue-meters, timing devices and sound spectography was that as Sherman

(25) has pointed out, the physical characteristics of a sound unite unpredictably in effecting a value on a physical scale which is not necessarily equal to their psychological stimulus value.

Since this is a test of psychological preception rather than physical structure of sounds, the board of judges or auditors has been used to measure the similarities or differences in testing stimuli.

Simultaneous presentation of stimuli. In order to provide a signal to prepare the subject for the test stimulus, the basal [ɝ] recording was opened at its splice and the signal *now* was inserted so that this tape when again spliced circularly was heard as a two-second silence, the signal *now*, a two-second silence, and 15 seconds of continuous [ɝ].

The simultaneous presentation of the two stimuli being compared in each judgment was accomplished by the use of three standard Webcor tape recorders whose volume and base-treble controls were set constantly at their medial dial position for *all* recordings in this experiment. Sound source #1 contained the basal [ɝ] circular tape. Sound source #2 contained the four testing stimuli. Recorder #3 was a storage unit or receiving unit set on "record".

With the storage unit, recorder #3, set on record, sound source #1 was opened at the same volume used to record the tape being played. Two and one-half seconds after the beginning of each playing of the basal [ɝ], sound source #2 was opened at a volume determined to be sufficient for recognition of each of the four sounds when heard simultaneously within the basal sound.

Four tape strips resulted from the above operation. Each tape contained the basal sound, but each tape contained a different one of the test sounds, heard at a volume sufficient for perception during the middle ten seconds of the basal [ɝ] sound. This gives the perceptual sensation of zero time lapse between the presentation of stimuli.

Each of these four pairings was reproduced four times on tape by re-recording on a direct line.

Order of presentation. Two procedures were used in determining the order of presentation of stimuli. First, a split half order of presentation was chosen, so that an indicator of internal consistency would be available. Second, the stimuli were randomized. In accord with this plan, the stimuli of the first half of the test were randomized and this order was reversed for the last half of the test. As a final step in constructing the experimental test, the sixteen individual tapes of paired testing stimuli were spliced in the order shown in Appendix B.

Subjects. The test was administered to twenty children in the Kalamazoo Michigan, Public Schools who were chosen by their school speech therapists as having normal hearing and only a [ɝ] defect. The group contained 11 boys and 9 girls. Seven children were in the first grade, six in the second, six in the third, and one in the fourth. All had been receiving speech therapy for a year or more and were currently enrolled in the speech correction program.

CHAPTER III

TESTING PROCEDURE

Interview procedure. Each of the subjects was tested individually by the experimenter during the administration of both tests. Each child was seen twice by the experimenter. On the first occasion, the following identification was made: name, age, grade, and articulatory error. All of this data was verified by the school therapist. In the remainder of the first interview, the child was given the experimental test.

Administration of the experimental test. The subject was always seated facing the speaker of the tape recorder and approximately three feet from it. The experimenter sat beside the subject to operate the recorder and observe the child's responses. Each child was given the following instructions.

"This is a test to see how well you can tell if two sounds are alike or different. When I turn on the recorder you will hear a voice say one long sound - like this ... " (Here, the experimenter produced and prolonged an [ɝ] sound for several seconds.) "At the same time, right in the middle of this sound you are going to hear another voice. This voice may say the same sound or it may say a different one - listen ... " At this point, the experimenter turned on the recorder to a randomly located sample. As the basal sound began, he said, "Now, there's the first sound." As the experimental sound began, he said, "Now, there's the second sound."

"You will hear 16 other pairs of sounds. In some, the two sounds will be the same. In some, they will be different. Each time that you hear the two sounds, you are to tell me if they are the same or different and circle either the word "same" or "different" on your score sheet."

In a case where the child was too young to read the words on the score sheet, he was told to respond orally and the experimenter pointed to the proper word to circle in accordance with the child's response.

In all cases, the subjects were asked if they could hear the sounds adequately and none requested greater volume. Therefore, the recorder was always set at the same level at which the sounds were recorded originally.

Administration of the Templin Test. One week after the administration of the experimental test, the same subjects were given the Templin Test. The subject was always seated three feet in front of the experimenter and facing in the opposite direction so that he (the subject) could not observe the experimenter's articulators. This was done so that both tests were measuring only auditory phonetic discrimination. For this test, the subject was given the following instructions.

"This is another test of your ability to tell if two sounds are alike or different. This week we will not use the recorder. Instead, I will say two sounds like this ... ta - da ... and you are to tell me if they are the same or different.

When the child made an incorrect response, its number was recorded on a tally sheet opposite the child's name.

CHAPTER IV

RESULTS

Tabulation of the raw data. Table I shows the raw data for each case. These data consist of:

(1) the total number of errors on the experimental test;

(2) the total number of errors on the Templin test;

(3) the ages of the children tested;

(4) the school grades of the children tested;

(5) the subject's typical substitution for the [ɝ] sound.

Statistical treatment of the data. Obviously, in a study such as this in which the underlying premise is that a basic difference is likely to exist between the two compared tests, the logical step is to attempt to disprove the null hypothesis as was stated in the first chapter. Ordinarily, the reliability of the differences that might be found would be determined by the use of the "t" test cited by Guilford (11:213). However, the two sets of measurements come from two different tests having different possibilities for scores. This variability made the use of this statistic unfeasible. The fact that the scores were not distributed normally made the use of the analysis of variance unjustifiable according to Guilford (11; 258). Hence, as a compromise measure it was decided to compute the coefficient of correlation (11: 160) and to make inferences as to the hypothesis just described, by means of the coefficient of alienation.

The computation of the correlation between the scores for the two tests is as follows:

$$r^2_{xy} = \frac{[N\Sigma xy - (\Sigma x)(\Sigma y)]^{+}}{[N\Sigma x^2 - (\Sigma x)^2][N\Sigma y^2 - (\Sigma y)^2]}$$

$$r^2_{xy} = \frac{[22420 - 21054]^2}{[163647 - 131769][8056 - 3364]}$$

$$r^2_{xy} = \frac{1366^2}{(31878)(4692)} = .013$$

$$r = .11$$

The resultant coefficient of correlation (r) is .11. In order to infer to what extent the null hypothesis might be valid, the coefficient of alienation was computed from the observed _r_. The computation of _k_ (the coefficient of alienation) was as follows:

$$k = \sqrt{1 - r^2} = \sqrt{1 - .013} = \sqrt{.9870} = .99$$

The value of _k_ was determined to be .99.

The lack of relationship between the two tests is therefore almost complete. One may infer very reasonably that the _null hypothesis is disproved. This means that there is no relationship between the Templin and the experimental tests._

Errors related to scores on the two tests. Of the 19 children tested, 11 substitutes [ʊ] for [ɝ] and 8 substituted [ɜ] for [ɝ]. In both instances, the mean for either group was within .9 of a point from the mean for the total group on either test. The data are shown in Table III. This could possibly indicate that the type of error substituted for a phoneme does not bear much relationship to the scores obtained on phonetic discrimination tests, or for that matter on discrimination ability.

This may perhaps relate to Anderson's study (2) which indicates that there is no relationship between substitution type errors and discrimination ability.

Age related to scores on the two tests. Table II gives the mean number of errors for each age group on the Templin and experimental tests. It can be seen that all age groups on both tests fell within one standard deviation of the mean for the total population on that test. Whereas the Templin Test showed no other trend or pattern in this regard, it may prove important that the scores for each age group on the experimental test indicate a trend for better discrimination ability for older children.

TABLE I

INDIVIDUAL COMPARISON OF ERRORS ON THE TWO TESTS

Subject.	Age .	Grade.	Error .	Number of Errors	
				Templin	Experimental
1	8	3	[ɜ]	18	0
2	8	3	[ɜ]	13	4
3	7	2	[ʋ]	39	9
4	8	1	[ʋ]	31	0
5	9	3	[ʋ]	21	1
6	7	1	[ɜ]	19	2
7	10	3	[ɜ]	24	3
8	8	3	[ʋ]	13	3
9	8	2	[ʋ]	10	12
10	6	1	[ʋ]	25	3
11	7	2	[ɜ]	12	1
12	7	2	[ɜ]	33	5
13	6	1	[ɜ]	12	11
14	6	1	[ɜ]	21	1
15	7	2	[ʋ]	9	1
16	7	1	[ʋ]	28	1
17	7	1	[ʋ]	17	0
18	10	4	[ʋ]	13	1
19	8	2	[ʋ]	15	0

TABLE II

AGE AS RELATED TO TEST SCORES

Age group	Templin mean error	Experimental mean error
6	18.8	3.8
7	23.3	3.1
8	16.6	3.1
9	21.0	1.0
10	18.5	2.0

TABLE III

ARTICULATION ERROR AS RELATED TO TEST SCORES

Articulation error	Number of cases	Discrimination errors	
		Templin	Experimental
[ʊ]	11	20.0	2.8
[ʒ]	8	19.0	3.9

CHAPTER V

SUMMARY OF RECOMMENDATIONS AND CONCLUSIONS

Restatement of orientation. A preliminary review of the literature on phonetic discrimination indicated that although this ability was considered by many authors as important to the correction of defective articulation, the research studies dealing with this ability have shown conflicting and inconclusive results. A further review of the literature suggested that some of the conflicting results were due to variables operating in the tests themselves. Seven of these uncontrolled variables were listed as follows: (1) position of the sound in context, (2) per cent recognizability of the sounds, (3) variations of stimulus presentation due to inconsistency and length of time lapse between presentation of stimuli and to phonemic production differences in experimenters, (4) auditory memory span, (5) poor definition of what is being tested, (6) fatigue, and (7) the use of general discrimination stimuli to test specific discrimination ability.

Therefore, it was hypothesized that an experimental test of auditory phonetic discrimination which minimized these seven variables would differ significantly from the Templin test and others like it which include all of these seven factors. In order to determine this, the null hypothesis was tested.

Restatement of Materials and Procedures. To test this hypothesis, 19 children in the first through fourth grade having only an [ɝ] defect were administered both the Templin and experimental tests. The Templin test consists of 70 pairs of two phoneme nonsense syllables (si - fi) read to the subjects orally by the experimenter.

The experimental test is a *shorter*, (16 judgment) recorded test of auditory phonetic discrimination in which *one isolated phenome*, [ɝ], is compared with itself, [ɝ], and three sounds frequently substituted for it [ɜ], [ʊ], and [ʌ]. The [ɝ] sound is called the *basal* sound. It is heard for 15 seconds. The other sounds compared with the basal sound are called the *experimental* or introduced sounds. In the test, the basal sound is presented 16 times for a duration of 15 seconds. During the time this sound is audible, one of the four experimental sounds is introduced *simultaneously* with the middle ten seconds at a loudness level which can be heard over the basal sound. Thus, the two sounds are not only heard simultaneously but the experimental sound is always heard with zero time lapse between itself and the beginning and ending five seconds of the basal sound. The subjects were all asked to tell if the introduced sound was the same as or different from the basal sound.

Summary of results. In order to test the hypothesis, the product-moment *r* was computed between the scores obtained on both tests and this measure was translated into a coefficient of alienation. The coefficient of alienation was computed to be .99, indicating an almost complete lack of relationship between the two tests, thus, disproving the null hypothesis and supporting the premise of this project.

Implications for discrimination testing. The conditions under which these differences appear could be due to either of the following. First, the two tests could be testing two different kinds of discrimination. The Templin may be testing the ability to tell the difference between two recalled nonsense syllables while the experimental test may be testing the ability to tell the difference between two isolated sounds. Second, the two tests may be measuring the same discrimination ability but the variables operating in the Templin Test could be causing the inconsistency evidenced between the two tests.

The probability of the latter seems most plausible due to the fact that other research, as indicated in the review of the literature, has shown these variables to be factors suspected of influencing the Templin and tests like it in previous research.

For a more complete choice between these alternatives, research in the future should try to determine more specifically how these variables (taken as a group in this experiment) relate to auditory phonetic discrimination individually. There should also be an investigation of the possibility of different kinds or levels of discrimination, as, for example, telling the difference between two sounds, two syllables, and two words. This latter problem is one of defining phonetic discrimination more accurately.

Findings related to therapy. One of the novel features of this experimental test was the simultaneous presentation of testing stimuli. This technique was used here to minimize the child's use of his auditory memory span and also to shorten the total time used to present the test. Future research might well investigate the use of simultaneous presentation of the "good" and faulty sounds for the purposes of ear training therapy.

As an aid to therapy, it is also suggested that the therapist should suspect different discrimination abilities for the different stages in therapy and test accordingly. This means that investigation of a particular case's skill at discrimination should be made whenever a new or different sound is brought into therapy. It also means that when the case progresses from isolated sounds production, to work with nonsense syllables, and on to word and sentence training - he should be tested on his skill to discriminate at each of these sentence levels. It is recommended, however, that the tests used be as free as possible from influencing variables.

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APPENDIX A

THE TEMPLIN TEST

APPENDIX A

THE TEMPLIN TEST

A

1. te . te
2. hwe . hwe
3. ne
4. ðe
5. fe
6. he
7. se
8. ðe . ðe
9. ʒe
10. vo

B

1. ne
2. dʒe
3. ʃe
4. im
5. hwi
6. qe . qe
7. dʒe
8. fai
9. ðe
10. pe . pe

C

1. fo
2. vo
3. zo . zo
4. ʃe
5. fi
6. ze . ze
7. mai . mai
8. θe
9. ne . ne
10. dʒi

D

1. pi
2. tʃo
3. ki
4. eb . eb
5. ehwe
6. en
7. eð
8. ehe
9. ou . ou
10. eθ . eθ

E

1. eʒ
2. ov
3. ed
4. eN
5. edʒ
6. eʃ
7. imi
8. ihwi
9. eq
10. is

F

1. eʒ
2. et
3. ep . ep
4. of
5. ov
6. ed
7. em . em
8. eð
9. airi
10. eʃ

G

1. if
2. ain
3. ini
4. ef
5. eð . eð
6. idʒ
7. ep
8. atʃ
9. ini
10. ez

APPENDIX B

STATISTICS USED IN THE COMPUTATIONS

APPENDIX B

STATISTICS USED IN THE COMPUTATIONS

I. Coefficient of correlation

$$r^2_{xy} = \frac{[N \Sigma xy - (\Sigma x) (\Sigma y)]^2}{[N \Sigma x^2 - (\Sigma x)^2[N \Sigma y^2 - (\Sigma y)^2]}$$

II. Coefficient of alienation

$$r = \sqrt{1 - r^2}$$

APPENDIX C

SCORE SHEET FOR THE EXPERIMENTAL TEST

APPENDIX C

SCORE SHEET FOR THE EXPERIMENTAL TEST

1.	SAME	DIFFERENT
2.	SAME	DIFFERENT
3.	SAME	DIFFERENT
4.	SAME	DIFFERENT
5.	SAME	DIFFERENT
6.	SAME	DIFFERENT
7.	SAME	DIFFERENT
8.	SAME	DIFFERENT
9.	SAME	DIFFERENT
10.	SAME	DIFFERENT
11.	SAME	DIFFERENT
12.	SAME	DIFFERENT
13.	SAME	DIFFERENT
14.	SAME	DIFFERENT
15.	SAME	DIFFERENT
16.	SAME	DIFFERENT

APPENDIX D

ORDER OF PRESENTATION OF STIMULI

FOR THE EXPERIMENTAL TEST

APPENDIX D

ORDER OF PRESENTATION OF STIMULI FOR THE EXPERIMENTAL TEST

1. ʌ ________
ɝ ____________
2. ɝ ________
ɝ ____________
3. ʊ ________
ɝ ____________
4. ɜ ________
ɝ ____________
5. ʊ ________
ɝ ____________
6. ʌ ________
ɝ ____________
7. ɜ ________
ɝ ____________
8. ɝ ________
ɝ ____________
9. ɝ ________
ɝ ____________
10. ɜ ________
ɝ ____________
11. ʌ ________
ɝ ____________
12. ʊ ________
ɝ ____________
13. ɜ ________
ɝ ____________
14. ʊ ________
ɝ ____________
15. ɝ ________
ɝ ____________
16. ʌ ________
ɝ ____________