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An Experimental Study of the Effect of Stimulation in the Prognosis of Defective Articulation

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AN EXPERIMENTAL STUDY OF THE EFFECT OF STIMULATION IN THE PROGNOSIS OF DEFECTIVE ARTICULATION

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CHAPTER I

INTRODUCTION

Many speech clinicians who work in elementary schools discover that one of their major concerns involves the selection of their case loads. The clinician must predict which children need her help to improve their defective articulation and which children will improve spontaneously. This is an especially difficult problem at the kindergarten, first and second grade levels. Because a large percentage of children at these levels have some type of defective articulation, time will not permit the speech clinician to help all of the children. She must be careful that her case load does not become so great that she cannot adequately help those who need her assistance to overcome their speech defects. Therefore, the clinician needs some type of prognostic tools to aid her in her case selection.

Statement of the Problem

It was the purpose of the study (1) to investigate the degree of improvement in defective speech among first grade children by comparing responses the children made on two articulation tests at the beginning of the school year with responses made on the same tests six months later and (2) to determine whether or not stimulation has prognostic value for the school speech clinician.

Importance of the Study

Speech clinicians in our school systems realize that they need some prognostic tools when choosing their case loads. Because maturation plays such an important role in the development of speech sounds, the clinicians may be spending too much time with children who will probably improve on their own, and they may be slighting the children who are in real need of their aid.

Snow and Milisen (1954b) reported the probability that a valuable tool in predicting a child's ability to overcome his articulation errors might be found in the difference between his responses to picture and oral articulation tests. They also found that sounds which were most readily corrected when given the oral articulation test tended to improve first and with the least difficulty.

Later a study by Carter and Buck (1958) indicated that there is statistically significant predictive value in using the nonsense-syllable type of test as compared with a spontaneous articulation test.

Farquhar (1961,p. 346) also concluded that stimulation could have value as a prognostic tool when she stated: 'The results of this study suggest that the speech clinician may utilize the imitation of words and nonsense syllables as prognostic tools.'

It was on the basis of the study by Carter and Buck (1954) and Farquhar (1961) that the present study was made. It was the intent of the examiner to test the merits of stimulation as a prognostic tool. The null hypothesis to be tested is that the two variables, improvement of error sounds in response to auditory-visual stimulation and spontaneous improvement in articulation over a five to six month period, are not associated.

Definition of Terms

Picture or Spontaneous Articulation Test. This test includes a set of pictures for purposes of testing a child's ability to produce spontaneously a correct sound when naming what he sees in the picture. There are usually three pictures presented for each sound. One picture uses the sound in the initial position of a word, one in the medial position, and one in the final position; that is, to elicit the sound of [s], pictures of sun, basket, and house might be shown to the child. A record is kept of each response the child makes.

Stimulation. If a child makes an error on any particular sound in any of the three positions in the word, the child is asked to carefully watch and listen to the examiner and repeat the isolated sound, nonsense syllable, or word which the examiner says. Thus, the child is receiving both

visual and auditory help (stimulation) to produce the sound. This definition of stimulation is based on the term used by Scott and Milisen (1954,p. 38): 'In the stimulation method, however, the stimuli presented to the student are auditory and visual: a model sound is presented by the therapist and the student imitates what he sees and hears.'

Nonsense Syllables. These are syllables containing a consonant sound and one or more vowel sounds. If the [s] sound were being tested in nonsense syllables, syllables such as the following could be used: [sɑ], [ɑsɑ], [ɑs], or [so], [oso], [os]. It should be noted that the [s] sound is used initially, medially, and finally in these nonsense syllables.

CHAPTER II

REVIEW OF THE LITERATURE

Various studies have been done in the past to discover effective means of determining prognosis for defective articulation. Included in these studies are the effects of maturation, stimulation, auditory discrimination, motor proficiency, environmental factors, the relationship of the classroom teacher to speech defective children, and the efficiency of a battery of diagnostic tests.

Some of the earliest prognostic studies made note of the effect which maturation has on the child's development of articulation. The studies of Poole (1934), Wellman and others (1931), Templin and Steer (1939), Roe and Milisen (1942), Spriestersbach and Curtis (1951), and Templin (1952) indicated that maturation has a great influence on the development of articulation when a child is between the ages of three and eight.

Roe and Milisen tested 1,989 children who were in grades one through six and found that children in the first, second, and third grades made a significantly greater number of errors than those who were older. This indicated that maturation and growth of the children were important for overcoming articulation difficulties.

According to a study by Templin (1952), children whose articulation develops normally need 7.6 years to complete their development of speech sounds.

Although Spriestersbach and Curtis (1951) were interested in considering the inconsistencies of misarticulation, they indicated that there is an increase in correctly produced consonants as the child matures.

A longitudinal study was made by Steer and Drexler (1960) to determine the effect which maturation had on the defective speech of young children. The results of this study indicated that at the kindergarten level, the measurement of certain variables did have predictive values. In this article, these variables appeared to be: (1) the total number of errors in all positions within words, (2) errors in the final position, (3) errors of omission in the final position, and (4) errors in the [f], [l] consonant group. This study suggested that by testing children at the beginning of the kindergarten year and again in the spring, a clinician could determine which children to choose for her case load by noting which children showed little or no improvement during that period of time.

Because published research indicated a controversy about the relationship of articulatory skill and a child's auditory discrimination ability, Mary Farquhar (1961) investigated this aspect to determine whether or not it had any

prognostic implications. Farquhar's tests of auditory discrimination included the ability of the child to discriminate the correct form of the misarticulated sound among vowels, among acoustically dissimilar sounds, and among acoustically similar sounds. She also administered an imitative articulation test consisting of an examination of the child's ability to reproduce after the examiner, the correct form of his misarticulated sound in isolation, nonsense syllables, and words. Seven months later the children were retested. The children received no therapy during that period of time. The tests indicated that the auditory discrimination tests used in this study did not show prognostic significance, but that the imitative tests did indicate a prognostic significance.

Another study to test the prognostic value of auditory discrimination by Stanley Dickson (1962) used the Templin Test to test speech sound discrimination. Dickson's findings were consistent with those of Farquhar which showed that the predictive value of speech sound discrimination ability appears to be minimal. Dickson did find that speech sound discrimination seems to be more clearly related to maturation. To test motor proficiency, Dickson used the Oseretsky Test of Motor Proficiency which measures six motor skills and provides scales for ages. Dickson discovered that the test revealed a significant difference between children who had outgrown functional articulation disorders and those who had

not. He found that the group which outgrew functional speech errors were able to complete significantly more motor tasks than those who had not. This author concluded there might be a positive relationship between gross motor ability and production of complex sound patterns and that a motor deficit may be related to functional articulation errors. As the child's motor proficiency improves, so may his articulation ability.

Dickson studied the personality characteristics of parents by asking the parents to complete the MMPI (Minnesota Multiphasic Personality Inventory). This test did not clearly reflect personality differences between parents of both groups of children, although mothers of children with speech defects tended to obtain scores in the direction of the so-called critical areas.

Another prognostic study was completed by Pettit (1957) to determine the prognostic efficiency of a battery of diagnostic tests commonly used by clinicians. The tests were the pure tone audiometric, speech perception, imitation of non-English sounds, imitation and articulation of English sounds, memory span, gross motor control, specialization of movement, speed of muscle movement, the California Test of Mental Maturity, and the California Test of Personality. His conclusion was that these tests were not efficient in predicting the articulatory development of "normal" children who were five years old.

There is some disagreement about the amount of responsibility which the classroom teacher should have with respect to the child who has defective articulation. Pendergast (1963) pointed out that teachers and clinicians should understand the difference between speech improvement and speech therapy. The classroom teacher should be responsible for the speech improvement program and the clinician the speech therapy program. She listed the following steps which should be taken by the classroom teacher: (1) take sufficient time to establish a classroom atmosphere of ease, confidence, and mutual self-respect for success in speech; (2) observe child's participation in speech during informal times in the classroom and during oral language time; and (3) note weaknesses in speech habits and refer all children with such weaknesses to the speech clinician. However, she pointed out that the classroom teacher should not diagnose the children's speech problems. Part of a favorable prognosis for children with defective speech rested upon the cooperation between the classroom teacher and the speech clinician.

Allen and others (1966) disputed Pendergast's article and the responsibility which the classroom teacher has toward the speech defective child. Their major reasons seemed to be: (1) that they did not believe that the ability to imitate error sounds correctly had predictive value and (2) that they did not think that the seriousness of the child's

articulation problem was taken into account sufficiently. However, Pendergast (1966, p. 548) herself defended her article by stating that she felt the introduction to the article by Allen and others was "inaccurate and misleading." Pendergast differentiated between speech problems that might be safely handled by the classroom teacher and those that would require the services of a speech clinician on a number of bases. One of these was: 'Articulation defects: Non-developmental misarticulations (sound omissions, substitutions, and distortions resulting from an inability to say the sounds correctly in isolation).' She suggested that these be handled by the speech clinician.

The studies, which seem to have the greatest prognostic significance, were those by Snow and Milisen (1954b), Carter and Buck (1958), and Farquhar (1961) which indicated that there was significant improvement in articulation test results when responses were imitative rather than spontaneous, and that a child's ability to correct himself when given oral stimulation could have prognostic significance.

The study by Snow and Milisen (1954b) investigated the degree of improvement in defective speech by comparing responses children made on spontaneous pictorial tests and oral stimulation-type tests. These tests were given to first and second grade children who had defective articulation and who received no speech therapy for the following six months. At

the end of the six month period, they were retested with the picture test. This study indicated that noting the difference between a child's responses to a picture and an oral articulation test could have very good predictive value for the speech clinician. This study found that the greater the difference between the two responses, the greater the improvement the child showed in his defective speech when he was tested six months later. The study also demonstrated that the sounds which the child corrected the most of the oral stimulation test were the sounds which should most easily show spontaneous improvement in articulation.

In a pilot study carried out by Buck and Perritt, as cited by Carter and Buck (1958), it was noted that some of the children who misarticulated in both spontaneous and imitation tests were able to correct their errors in nonsense syllables. To test this aspect further, Carter and Buck (1958) attempted to devise a prognostic articulation test and investigate the effect of therapy on first grade children who had defective speech. This test was the series of three tests which Buck and Perritt had used. The first test was one which required the children to give spontaneous responses, the second test provided for stimulation on the part of the administrator, and the third test was a nonsense syllable test using the same consonantal sounds represented in the words used in tests 1 and 2. The tests were

administered to 175 first grade children who were found to have defective articulation. The children were divided into two groups. The control group consisted of 83 children who received thirty-minute therapy sessions twice a week for the entire school year. The experimental group consisted of 92 children who received no special therapy help. The three tests were administered in the fall of the year and the spontaneous test was administered again at the end of the school year. Results of their testing tended to show that the higher the percentage of correction which the children made on the nonsense syllable test, the more accurate will be the prediction that these children will overcome their defective articulation without the aid of therapy. The authors concluded that a score of 75 per cent or more on the nonsense syllable test is probably indicative of this improvement. The results also showed that of the children in both groups who made no corrections on the nonsense syllable test in the fall, the ones in the control group who received therapy had a greater percentage of 100 per cent final correction than those who were in the experimental group; furthermore, the percentage of no correction was greater in the experimental group than in the control group.

Earlier studies by Templin (1947,p. 300) indicated no statistically significant differences between responses children gave on a spontaneous picture test and those given on an imitation word-type test. In her article, she stated:

'There is no difference in measured articulation when a sound is tested in a word spontaneously uttered or in a word repeated after the examiner. . . . Careful judgments of any utterances, whether spontaneous or imitated are similar.' It should be noted that Templin scored responses as either correct or incorrect and did not differentiate between the seriousness of omissions, substitutions, and distortions.

CHAPTER III

PROCEDURES

Selection of Subjects

An articulation test composed of three parts was administered to 166 unselected first grade children during the month of September. The children who were tested attended four different Catholic parochial schools and one Lutheran parochial school. Four of the schools were located in one community and the fifth was located in another community 40 miles away. The four schools of the larger community represented a broad area of socio-economic groups. One school was located in an area of low-income families, two in a middle-income neighborhood, and the third in a high-income district. These children were chosen because they received no speech correction other than a speech improvement program carried on by classroom teachers.

Materials

The articulation tests were constructed in the following manner. A notebook was compiled using the individual pictures of the Photo Articulation Test (1965) and another set of pictures which paralleled those of the Photo Articulation Test (PAT), providing six responses for each sound, two in the initial position of a word, two in the medial, and two

in the final position. For ease of discussion, the other picture test will be referred to as the DAT. A recording sheet was prepared and duplicated which could be used either with the PAT or the DAT. (See appendix for a list of the words included in the picture tests and for a sample of the recording sheet.)

A total of twenty-four sounds was tested in these two tests.

The second test was the Stimulation Test. Seven spaces for each sound were provided on the recording sheet. One space was used for recording the response of the isolated sound after stimulation, three spaces were provided for recording responses to nonsense syllables (in initial, medial, and final positions) after stimulation, and three spaces were provided for the recording of responses after stimulation to the three words used in either the PAT or DAT tests.

Administration of the Tests

The responses to the sounds were recorded as correct ( ), substitution (the sound which was substituted was recorded), omission (-), or distortion (D_1 or D_2 according to the severity; D_1 being a mild distortion and D_2 a severe distortion).

After the first test was administered, the examiner quickly checked the recording sheet for error sounds. If,

for example, the [s] sound was produced incorrectly in any or all positions, the examiner asked the child to listen carefully and watch her lips as the sound was produced in isolation. The child was asked to repeat the sound and this response was recorded. This same procedure of stimulation was then used with the sound in nonsense syllables; for example, [sɑ], [ɑsɑ], [ɑs], and then in the word in which the error sound was made.

After each error sound was stimulated, the second test was administered and error sounds again stimulated with the method used above.

The use of the two tests was alternated, the PAT was administered first and the DAT second to an individual child, and the next child was tested first with the DAT and then with the PAT. This was done so that an element of fatigue might not show a discrepancy between the two tests.

The average time needed to administer the two tests ranged between ten and twenty minutes. If a child had many articulation errors, the testing was done at two different times to eliminate fatigue. The second testing took place later in the day or on the following day.

The children who responded with error sounds during the first testing in the fall were retested five to six months later during the month of March. Of the 166 children originally tested, 122 children were retested in March. The

remaining 44 had no error sounds on the first testing or had moved to other schools, and one child was receiving speech correction.

The Stimulation Test was not used for the retesting situation. If a child had one or more incorrect responses to a sound on the PAT and/or on the DAT, he was asked to give all six responses for that sound both on the PAT and the DAT. Comparisons were then made to note the amount of improvement made by each child.

CHAPTER IV

RESULTS

Method of Analysis

Responses which the children gave for the tests were converted into scores. A correct response was scored as (1), a slight distortion as (2), a severe distortion as (3), a substitution as (4), and an omission as (5).

Justification for these values may be found in the article by Snow and Milisen (1954a, p. 32): 'Clinical observation indicates that the direction of progress toward correction of a defective sound is from omission to substitution to indistinctness, though, of course, a sound does not necessarily go through each step. . . . it indicates a general trend from omission to substitution to indistinctness, and justifies the use of the rank order scale as described above.'

A Comparison of Improvement on the Stimulation Test with Improvement on the Final Test. The six scores given for each sound on the PAT and the DAT were totaled and divided by six to establish a mean score. The mean scores of all error sounds for each child were then added and divided by the number of error sounds, thus establishing an overall mean for each child. This same procedure was used for the Stimulation Test and for the Final Testing. For each of the 122

subjects, this produced one average score for the PAT-DAT tests, one average score for the Stimulation Test, and one average score for the Final Testing. The average score of the Stimulation Test was subtracted from the average of the PAT-DAT scores yielding an x variable. The mean score of the Final Testing was subtracted from the average of the PAT-DAT scores yielding a y variable. These scores showed the amount of improvement between the PAT-DAT scores and the Stimulation Test, and between the PAT-DAT scores and the Final Testing. The x and y scores were ranked from lowest to highest, and the Spearman Rank Correlation Coefficient (Siegel, 1956, pp. 206-210) was computed to test the null hypothesis. This hypothesis was that there was no difference in articulation improvement between the children who responded well to auditory and visual stimulation of their error sounds and the children who did not respond well. The result was significant beyond the one per cent level of confidence; therefore, the null hypothesis can be rejected. The difference between the subject's two ranks was computed, and the difference was squared. The sum of all values of d_i^2 was obtained. The Spearman Rank Correlation Coefficient (Siegel, 1956, pp. 202-213) was used for computing the level of significance. Because of a significant number of ties in the x and y variables, a correction factor needed to be incorporated into the computation of r (Siegel, 1956, pp. 206-210).

Since there was a large number of sample cases, the observed value of r was determined by computing the t associated with that value (Siegel, 1956, p. 212).

The final result, which compared the amount of improvement on the Stimulation Test with that on the Final Testing, was t=5.43 which, according to Table B of Siegel (1956, p. 248), is significant beyond the one per cent level of confidence.

A Comparison of Improvement Using Nonsense Syllables with Improvement on the Final Test. Because Carter and Buck (1958) concluded that a comparison of the spontaneous picture test results with those of the nonsense syllable test appeared to be a reliable prognostic tool, the examiner wished to compare the final results of this study with final results obtained using only the portion of the Stimulation Test containing nonsense syllables. In other words, only scores for responses to the nonsense syllables in the Stimulation Test were averaged for each child and subtracted from the child's average for the PAT-DAT scores. This procedure altered the x variable. The final result, which compared the amount of improvement on stimulation of nonsense syllables with that of spontaneous articulation improvement on the Final Testing, was again significant beyond the one per cent level of confidence. The null hypothesis can be rejected.

A Comparison of Improvement on the Stimulation Test with Improvement on the Final Test of Children Having Mild Articulation Errors. Clinicians often question the inclusion of children with mild articulation problems in their case load. In this study 30 of the 122 children with articulation defects had only one error sound. The aforementioned statistical procedure was used to compare the amount of improvement for these sounds on the Stimulation Test with the amount of spontaneous improvement of these sounds on the Final Testing. The result was t=4.07 which is significant beyond the one per cent level of confidence and again the null hypothesis was rejected. This would indicate that children with mild articulation errors tend to overcome their errors without the help of the speech clinician.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary and Conclusions

Three articulation tests were administered to 122 unselected first grade children who received no speech correction from a speech clinician during the school year. A spontaneous picture test and an auditory and visual stimulation test were administered to the children in the fall of the year, and the third test which retested error sounds of the spontaneous test was given six months later.

The purpose of this study was to investigate the degree of improvement in the defective speech of these children by comparing responses the children made in the fall with their responses to the final test in the spring, and to determine the significance of stimulation as a prognostic tool for the school speech clinician. Results of this study indicated beyond the one per cent level of confidence that responsiveness to an auditory and visual stimulation test has prognostic value in predicting which first grade children with defective articulation will show spontaneous improvement over a six month period. The children who tended to show improvement between the PAT-DAT tests and the Stimulation Test tended to improve most on the Final Testing. Those who did not improve on the Stimulation Test or who showed only

slight improvement tended to show little or no improvement on the Final Testing.

The results tend to refute the statement by Templin that there is no difference in the response of a child if the word is spontaneously spoken or is repeated after the examiner has spoken it.

However, this study does lend support to the conclusion of Snow and Milisen (1954b), Carter and Buck (1958), and Farquhar (1961) which propose that the ability of a child to correct his misarticulations after stimulation could be an indication to some degree of the amount of improvement which will result in his speech without speech correction.

Because a child's stimulability can be indicative of the amount of improvement he will experience through speech maturation, using a stimulation test after administering a spontaneous articulation test could provide an important prognostic tool for the school speech clinician.

Recommendations

It is recommended when spontaneous articulation tests are given to speech defective children that the speech clinician stimulate any defective sounds and keep a record of the child's responses. Those children who correct their defective sounds upon stimulation would not be regularly included in the clinician's active case load. Those children showing moderate improvement upon stimulation would be put in a

therapy questionable group, and although not included in the active case load, would be retested about the middle of the school year and included in the case load at this time if there is no improvement. Those children who show little or no improvement with stimulation would be immediately enrolled in the speech correction program.

It should be kept in mind that the speech clinician must keep records of those children she chooses not to include in her case load based on the concept of stimulability. These children must be retested, possibly at the beginning of the following school year, and if little or no speech improvement is noted, they must receive speech therapy.

In making decisions about which children to include in the active case load, other relevant factors should also be taken into consideration. These factors would include: (1) lack of intelligibility of the child's speech and (2) the emotional maladjustments of the child or his listeners.

Because this study indicated that the degree of difference between using the complete Stimulation Test (isolated sounds, nonsense syllables, and the sound in words) and using a stimulation test composed only of nonsense syllables shows no significant difference in results, the school speech clinician might consider using only nonsense syllables for stimulation which would speed the administration of the Stimulation Test. According to Carter and Buck (1958, p. 132), the speech

clinician '. . . might expect that those children who make no correction on this test will need therapy to correct their misarticulations. She may become more efficient with these children by excluding those who achieve 75 per cent or more correction on the Nonsense-syllable Test.'

Besides serving as a prognostic tool, the Stimulation Test can serve another purpose. It can help the speech clinician plan her therapy. A child may have several defective speech sounds, some of which will show improvement upon stimulation and others which will be resistant to it. The clinician can begin her therapy by working with those sounds which were stimulable, thus providing an opportunity for the child to experience a measure of success.

Although this study and others have indicated that stimulation can be a very valuable prognostic tool for the speech clinician, she should not rely on one tool alone. She should consider the values of other prognostic studies to assure herself that, to the best of her knowledge, she is choosing children for her case load who will gain the most benefit from her assistance. She should not exclude children arbitrarily when other factors point strongly to a need for clinical help.

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APPENDICES

PAT:

	Initial	Medial	Final
[s]	saw	pencil	house
[z]	zipper	scissors	keys
[ʃ]	shoe	gas station	fish
[tʃ]	chair	matches	sandwich
[dʒ]	jar	angels	orange
[t]	table	potatoes	hat
[d]	dog	ladder	bed
[n]	nails	bananas	can
[l]	lamp	balloons	bell
[θ]	thumb	toothbrush	teeth
[r]	radio	carrots	car
[k]	cat	crackers	cake
[g]	gun	wagon	egg
[f]	fork	elephant	knife
[v]	vacuum cleaner	television (TV)	stove
[p]	pipe	apple	cup
[b]	book	baby	bathtub
[m]	monkey	hammer	comb
[w]	witch	flowers	
[ð]	this, that	feathers	bathe
[h]	hanger		
[ŋ]		hanger	swing
[j]	yes	thank you	
[ʒ]		measure	beige

DAT:

	Initial	Medial	Final
[s]	scissors	basket	dress
[z]	zebra	razor blades	eyes
[ʃ]	shovel	sewing machine	paint brush
[tʃ]	church	picture	watch
[dʒ]	giraffe	soldier	bird cage
[t]	turtle	tractor	foot
[d]	doll	radio	bird
[n]	nose	raincoats	train
[l]	leaf	color	ball
[θ]	thimble	birthday cake	mouth
[r]	rake	turtle	door
[k]	corn	monkey	book
[g]	gate	tiger	pig
[f]	fan	telephone	leaf
[v]	valentine	oven	glove
[p]	pencil	slipper	lamp
[b]	banana	ribbons	crib
[m]	moon	fireman	broom
[w]	wagon	sandwich	
[ð]	these, those	father	smooth
[h]	house		
[ŋ]		finger	ring
[j]	yellow	onions	
[ʒ]		treasure chest	collage

RECORDING BLANK

Name of Test_____ Date of Test_____

Name of Child_____ Age___ Sex___ Birthdate_____

Grade___ School_____ City_____ State_____

Understanding of spoken language: Good___ Fair___ Poor___
Intelligibility of speech: Good___ Fair___ Poor___
Rhythm of speech: Good___ Fair___ Poor___
Voice: Good___ Fair___ Poor___
Estimate of language ability: Good___ Fair___ Poor___

Organic Problems Noted:_____

_____

KEY: Omission: (-); substitution: write phonetic symbol of sound substituted; distortion: D1 - slightly distorted, D2 - distorted; correct response: (✓).

PICTURE TEST

Isolated Word Test					Isolated Nonsense Syllables				Words		
Sound	I	M	F		Sound	I	M	F	I	M	F
s											
z											
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Comments:

APPENDIX C

SUMMARY OF RAW DATA

MEAN SCORES OF 122 FIRST GRADE CHILDREN WITH DEFECTIVE ARTICULATION

Identifying Number	PAT/DAT Mean Score	Stimulation Test Mean Score	Final Test Mean Score
1	1.20	1.05	1.00
2	2.21	1.21	1.63
4	1.20	1.00	1.00
6	2.00	1.07	2.08
7	2.16	1.83	1.75
9	3.00	2.48	2.63
11	1.50	1.40	1.00
15	1.50	1.00	1.00
16	2.50	1.00	1.50
18	2.25	1.00	1.42
20	1.63	1.00	1.75
21	1.56	1.00	1.31
22	2.28	1.45	1.75
23	1.92	1.33	1.20
24	1.59	1.15	1.00
25	3.80	3.70	3.80
28	1.83	1.00	1.17
29	1.50	1.07	1.25
30	1.71	1.00	1.00
32	3.50	1.36	2.79
33	1.95	1.00	1.40
37	1.50	1.00	1.00
38	2.42	1.56	2.00
39	2.25	1.13	1.31
40	2.33	1.87	1.67

Identifying Number	PAT/DAT Mean Score	Stimulation Test Mean Score	Final Test Mean Score
42	1.50	1.00	1.25
45	1.58	1.00	1.25
46	2.00	1.40	1.00
49	1.83	1.00	1.25
50	2.00	1.00	2.00
51	2.56	2.02	2.02
54	2.60	1.40	1.85
55	2.50	1.00	2.00
56	1.50	1.00	1.25
57	2.92	1.65	2.19
58	3.19	2.65	2.39
59	1.50	1.00	1.25
60	1.80	1.00	1.00
61	1.50	1.00	1.00
62	1.67	1.07	1.00
63	2.42	1.66	2.67
64	1.50	1.00	1.50
65	2.35	1.64	1.87
66	2.68	1.87	2.04
67	1.50	1.00	1.50
68	2.25	1.17	1.58
70	2.00	1.25	1.75
71	2.13	1.61	1.00
73	2.50	1.00	1.50
74	1.80	1.00	1.00
75	2.36	1.83	1.28
76	1.50	1.00	1.00
77	1.50	1.00	1.25
78	1.50	1.00	1.00
79	1.50	1.00	1.25

Identifying Number	PAT/DAT Mean Score	Stimulation Test Mean Score	Final Test Mean Score
81	2.92	2.25	1.92
82	2.25	1.25	1.25
83	3.14	2.12	2.53
85	2.39	1.24	2.28
86	2.33	1.43	1.17
87	1.88	1.25	2.25
88	2.45	1.43	1.85
89	1.50	1.00	1.00
90	1.67	1.00	1.25
91	2.80	1.16	1.65
92	1.50	1.00	1.25
93	2.28	2.05	1.50
94	1.50	1.65	1.42
96	1.80	1.00	1.00
98	1.50	1.00	1.50
99	2.34	1.18	1.00
100	1.63	1.00	2.38
101	1.72	1.38	1.42
102	2.31	1.45	1.31
103	2.03	1.28	1.15
107	2.25	1.25	2.25
108	1.63	1.00	1.43
109	1.50	1.00	1.00
110	3.67	2.68	1.83
112	1.50	1.00	1.50
113	1.50	1.00	1.00
114	1.81	1.36	1.72
115	2.17	1.02	1.67
116	1.94	1.00	1.31
117	1.63	1.32	1.00
118	1.63	1.00	1.38

Identifying Number	PAT/DAT Mean Score	Stimulation Test Mean Score	Final Test Mean Score
119	2.92	1.81	1.80
120	2.28	1.57	1.90
121	2.00	1.00	1.00
124	3.50	2.39	3.00
125	2.75	1.44	2.23
127	1.63	1.00	1.75
128	2.50	1.00	1.50
129	1.83	1.00	1.92
132	2.13	1.82	2.00
133	2.95	1.84	2.36
134	1.68	1.06	1.14
136	2.33	1.45	1.50
137	2.38	1.38	1.38
138	1.50	1.00	1.00
139	1.80	1.00	1.40
140	2.98	2.28	1.47
142	1.63	1.00	1.38
144	1.50	1.00	1.50
145	2.52	1.45	1.42
146	1.50	1.50	1.00
148	2.75	1.25	2.13
150	1.50	1.00	1.00
151	2.14	1.43	1.79
152	1.75	1.00	1.42
153	1.50	1.00	2.00
154	1.79	1.29	1.44
155	1.50	1.00	1.00
156	1.89	1.27	1.50
157	1.81	1.00	1.42
158	1.58	1.00	1.78
159	2.50	1.10	1.20

Identifying Number	PAT/DAT Mean Score	Stimulation Test Mean Score	Final Test Mean Score
160	2.06	1.10	1.31
161	1.75	1.50	1.56
163	1.75	1.16	1.13
164	2.00	1.00	1.00
166	1.79	1.18	1.46

APPENDIX D

VERIFICATION OF ARTICULATORY JUDGMENTS

Three graduate students, two of whom had completed their graduate work, served as subjects to determine the experimenter's reliability as an interpreter of error sounds.

On a random sample of responses which were recorded, judgmental agreement with the experimenter's interpretation of a particular type error occurred 64 per cent of the time which by its very nature is better than chance occurrence. It can be assumed on this basis that the experimenter's judgments of error sounds are sufficiently reliable.