AN EXPERIMENTAL STUDY OF THE RELATIONSHIP BETWEEN TWO MEASUREMENTS OF ARTICULATION EFFECTIVENESS

by

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CHAPTER I

BACKGROUND AND RELATED RESEARCH

In the field of speech correction it is recognized that a correctionist must expect his case load to consist primarily of children with articulatory defects. He must further expect that most of these defects will be functional in nature. This is easily understood when one realizes that out of the elementary and high school population having speech disorders 75 to 80% are cases of functional articulatory disorders (6:711).

A primary aspect in a corrective program for the child with a functional articulation disorder is that of testing. The correctionist needs to know which sounds are defective and the degree of defectiveness. Articulatory testing is perhaps one of the most important and challenging aspects of a correction program, and it is with this aspect that this study will deal.

I. TESTING METHODS IN USE TODAY

Van Riper (9:50) states that the purpose of articulation testing is to, 'Compare the phonemes that are actually used by an individual with the phonemic structure of his language group.' In order to obtain a clear and comprehensive picture of the methods of testing in use today one may turn to Van Riper's (9:54-61) classi-

fication of testing techniques which are: (1) techniques which do not provide audio-visual stimulation, (2) techniques which provide some audio-visual stimulation, and (3) techniques which provide maximal audio-visual stimulation.

Before proceeding to an explanation of the three techniques it is necessary to understand that audio-visual stimulation is the demonstration by the examiner of the sound and/or movement of the sound which the child is to articulate. Thus, the first technique consists of having the child name pictures or objects, answer questions, or read word lists or sentences with no demonstration by the examiner.

The second technique of testing is sometimes called the 'say after me' method. In this method the child repeats isolated sounds, words, or sentences after the examiner.

The final technique is that of maximal stimulation and is basically the same as the second. However, the stimulus word or sound is repeated several times, each time stressing a different aspect of the sound. Thus, if the word 'ball' is the word to be tested the child will be told to watch the examiner as the word is articulated and to notice the articulatory movements made. The examiner then repeats the word a second time after directing the child to listen to the sound of the word.

The use of any stimulation has been criticized on the basis that articulation will show improvement when imitating a model and thus give an untrue picture of the child's speech. However, Van Riper (9:61) recommends the stimulation technique after the

defective sounds have been recorded to give the examiner an idea of how the child will respond under optimal circumstances and to ascertain if any sounds are almost ready to be made correctly.

Powers (5:773-778) recommends a three-fold examination. The first step consists of a phonetic inventory of the child's speech using the picture test to avoid influencing the responses. The second step is an appraisal of the severity of the disorder which can be done by listening to the child's off-guard conversational speech. Finally, Powers suggests an estimation or prognosis of the success of a remedial program to be carried out for the child.

Generally, articulation testing involves in some way eliciting speech from a child, recording the errors, making a subjective judgment of the severity of the problem, and making a prognosis as to the child's chances of correcting his errors through therapy.

II. ADDITIONAL CONSIDERATIONS IN ARTICULATION TESTING

While the current methods of testing articulation are by no means incorrect and do provide a far better means of evaluating a speech defect than simply accepting a parent's report of her child's difficulty, several authorities have considered the testing methods in use today to be inadequate.

In a report of the American Speech and Hearing Association Subcommittee on Articulatory Problems, Villareal, Schiefelbusch, Pronovost, and Milisen (10:15) state that the available procedures of articulatory testing need further evaluation and that new ones must

be developed.

Van Riper (9:61-62) lists five factors which complicate articulatory testing. They are: (1) some sounds are used more often than others, (2) some sounds appear earlier in the development of the speech of children, (3) some sounds appear to be easier for children to pronounce, (4) some sounds can be made in isolation, and, (5) the position of sounds within words vary. Five questions may then be raised concerning these factors; (1) Should one consider a misarticulation of a frequently used sound to be more handicapping than the misarticulation of a less frequently used sound? (2) Should only sounds of the right age level be tested or should one test all sounds and establish an articulatory age level? (3) Should only the easy or hard sounds be tested or both? (4) Should only the sounds which can be made in isolation be tested or only those which cannot? (5) Should a sound which may be found in either the initial, medial, or final position be tested in all or one of the positions?

In the report of the Subcommittee on Articulatory Problems in which a need for more evaluation of articulation testing was stated, a particular need was specified for adequate and usable scales of degree of severity of impaired articulation (10:15). This need for better testing methods is still more amplified by Powers (5:777) who states,

> It is to be hoped that further investigations will be made along the line of objectifying and measuring articulation. A valid, reliable, standardized, quantitative index of articulation would be extremely valuable, both for research purposes - so that articulation data could be handled

statistically and have a uniform meaning throughout the country - and for clinical measurement of progress with speech therapy.

It would seem, then, that what is needed in articulation testing is a method which gives a valid picture of the degree of severity and which takes into account the previously mentioned five complicating factors, particularly those of frequency of occurrence of sounds in speech and the developmental age level at which the sounds appear.

III. RELATED RESEARCH

The previously mentioned considerations have received attention in the form of many studies. Of particular importance are the following seven studies, three of which deal with the frequency of occurrence of speech sounds, and four of which deal with the developmental age levels at which sounds appear in speech.

Frequency of occurrence. The first important study in the area of frequency of occurrence of sounds and the severity of articulation disorders is that of Wood (12:256). The purpose of the Wood study was to ascertain if maladjustments in parents are related to functional articulatory disorders in their children. In order to have a convenient method of measuring the amount of articulatory defectiveness, Wood devised a scale called the Articulation Index (hereafter referred to as the AI) which results in numerical evaluation of articulation ability. This index was based on Travis' table of the relative frequency of occurrence of consonant

sounds, and the AI was determined by giving a relative weight to each sound and prorating that weight equally to the positions in which the sounds occur. The child's AI is the sum of the relative weights of the sounds misarticulated subtracted from 100 (12:259).

The fact that each position of a sound was prorated equally has been criticized, but Wood (11:173-174) explains that his reasons for the equal proration are two-fold. First, it is impossible to determine frequency of occurrence of the position of a sound in running speech because, while a sound may be final in an isolated word, the sound may become medial when the word is used in conversational speech. Second, when a sound is learned in one position there is partial learning for the other positions, and since it cannot be estimated how nearly a child comes to articulating a sound in one position as a result of learning it in another, the only solution is to give equal weight to the sound in all positions.

Despite Wood's explanations, Van Riper (9:13) maintains that the AI is not completely adequate, not only because of the equal values assigned to all positions of a sound, but also because vowels were not included in the Index.

Barker (1) also disagrees with Wood's exclusion of vowels in the AI. She feels that if a score is to accurately represent speech effectiveness it must include all the speech sounds (1:81). Barker set out to devise a scale similar to the AI but with vowels included. She chose the Bell Laboratory frequency of occurrence tables as the basis for the scale and, like Wood, prorated the

sound weights equally to all positions in which the sound occurs (1:82). The resulting score is called the Articulation Score (hereafter referred to as the AS). In order to validate the score, Barker first accepted Morrison's findings that trained judges could place recorded speech samples along a severity continuum (1:88). She then recorded the speech of her subjects, obtained ratings on the samples from a group of judges, and compared these ratings to the Articulation Scores (1:85). Since there is a correlation of .94 between the scores and the ratings, the AS may be considered to be valid (1:88).

These two studies provide a numerical score of articulation effectiveness based on tables of frequency of occurrence of sounds. Both have been considered valid, although one tests consonants only while the other includes vowels and diphthongs. The next step, obviously, is to ascertain whether or not the inclusion or exclusion of vowels makes a difference in the effectiveness of the scales. Shogren (7) has recently studies this problem, hypothesizing that the Wood and Barker scales are equally effective. Shogren's procedure was to calculate the AI and AS using the errors of Barker's subjects, to compare the judges' ratings from the Barker study, and to correlate this data (7:23-28). The results indicate that there is one chance in 2563 for a true and not a chance difference between the AI and AS (7:39). This supports the hypothesis that vowels need not be included in a test for articulation effectiveness in order to give a true picture of the child's speech ability (7:40).

Shogren then states in the conclusion of her study that, 'Due to the additional time involved in administering the AS and the fact that it does not contribute a significantly greater amount of information, therapists will probably continue to use the more efficient and just as effective Wood AI' (7:44).

Developmental age level. The developmental age level at which speech sounds appear and are incorporated correctly into a child's vocabulary is a second factor to be taken into consideration in articulation testing. As Miller (4:88) points out, people are aware that the number of different sounds a child produces increases as the child matures. But one must also realize that as Powers (6:714) states, 'In order to judge whether a child's misarticulations are normal for his age we must be aware of the developmental order of the sounds and the ages at which the various speech sounds normally appear.'

Two of the earliest studies on the developmental age level at which various phonemes appear are those of Wellman (8:19-20) and Poole (8:20). Wellman's sample consisted of 204 children from two to six years of age who were enrolled in the University of Iowa Laboratory Preschools. Poole's sample was smaller and included sixty-five children from two and a half to eight and a half years of age who were attending the University of Michigan laboratory schools. In both studies the children were given articulation tests and the results were analyzed and compiled into articulatory norms according to developmental age levels.

A more recent study is that of Templin (8). The norms extracted from her data are but a part of a large study on various language skills in children. Templin had a sample of 480 children from three to eight years, all of which were attending some form of school at the time of the study.

The norms from the three above-mentioned studies are shown in Table I on page 10. Norms from the Wellman and Poole studies are taken to be those phonemes at each age level which are correctly pronounced by 75% of the children tested. The norms from Templin's study, however, are given at both the 75% and 90% levels of correct pronunciation.

Articulatory norms have been put to use by Hejna (2), whose 1959 revision of the Developmental Articulation Test is based on age levels adapted from Templin's research. This research indicates the number of subjects at each age level correctly articulating the specific speech sounds. Using this table Hejna has established the age levels by which 90% or more of the children will have acquired the sounds (2). The twenty-six item test may be used to record the responses to picture cards of children aged three to eight and to check the results against the articulation norms given for their age groups.

The preceding studies provide information relative to the five questions arising from Van Riper's five complicating factors in articulation testing: (1) misarticulated sounds which are used frequently should be thought of as constituting a more severe articu-

TABLE I

COMPARISON OF DEVELOPMENTAL AGE LEVEL NORMS FOR CONSONANTS IN THE TEMPLIN, POOLE, AND WELLMAN STUDIES

Sound	Templin 90%	Templin 75%	Wellman 75%	Poole 75%
[m]	3	3	3	3.5
[n]	3	3	3	4.5
[ŋ]	5	3	-	4.5
[p]	3	3	4	3.5
[f]	4	3	3	5.5
[h]	3	3	3	3.5
[w]	3	3	3	3.5
[j]	5	3	4	4.5
[k]	4	4	4	4.5
[b]	4	4	3	3.5
[d]	5	4	5	4.5
[g]	4	4	4	4.5
[r]	6	4	5	7.5
[s]	7	4.5	5	7.5
[ʃ]	6	4.5	-	6.5
[ʧ]	6	4.5	5	-
[t]	6	6	5	4.5
[θ]	7	6	5	7.5*
[v]	7	6	5	6.5*
[l]	6	6	4	6.5
[ð]	8	7	5	6.5
[z]	7	7	5	7.5*
[ʒ]	-	7	-	6.5
[ʤ]	7	7	6	-
[hw]	-	-	5	7.5

* Templin (8:53) states in her study that an unpublished study of Poole reports the following shifts: [s] and [z] appear at 5.5 years, then disappear and return later at 7.5 years; [θ] appears at 6.5 years and [v] at 5.5 years.

lation disorder than the misarticulation of sounds less frequently used, (2,3,4) all sounds should be tested, and, (5) sounds should be tested in the positions in which they occur.

IV. SUMMARY

From the studies which have been done two types of articulation tests have been constructed, one assigning a developmental age level of articulatory performance, and the other assigning a numerical score of articulation effectiveness. The tests have filled a need in the field of speech correction, but there still remains a problem. A score on either the Wood AI or the Barker AS is taken to mean a certain degree of articulation effectiveness, and a low score is interpreted to mean that an individual's speech is ineffective. It would seem, however, that this score must be interpreted by certain standards. Thus, can one say that a three year old with an AI or AS of 40 is as ineffective in his speech as an eight year old having a score of 50 when one knows from the normative studies that a three year old cannot be expected to have as many phonemes in his sound vocabulary? The problem, then, appears to be one of assigning norms to numerical scores of articulation so that the scores of children will not be misleading.

CHAPTER II

PURPOSE OF THE STUDY

In the previous chapter it appeared that there is a need for concise and more meaningful measures of articulation effectiveness. It was established that while numerical measures of articulation effectiveness have been constructed there are no existing standards or norms to be taken into consideration when deciding if a child's score is normal for his developmental age level.

Because Templin's (8) study indicates that a child will have mastered all of the English phonemes by the age of eight, a numerical evaluation of articulation effectiveness for anyone older than eight will have meaning. However, for those children from three to eight a score is less meaningful unless one takes into consideration that at these ages children cannot be expected to have mastered certain phonemes.

The purpose of this pilot study is two-fold: (1) to assign a numerical articulation score to each age level of the Templin, Poole, and Wellman norms, and, (2) to compare these scores to scores actually received by a group of subjects who have been given an articulation test. It is hoped that a set of numerical articulation score norms for each age level will be indicated by the results obtained. A more expanded explanation of the procedure used in this study will be found in Chapter III.

CHAPTER III

PROCEDURE

In the preceding chapter the purpose of this study was stated as an attempt to establish numerical articulation score norms for each developmental age level. In order to achieve this a numerical score of articulation effectiveness was computed for each age level according to the sounds developed by that age. The expected scores were then compared to actual scores received by groups of children at each age level who had been given an articulation test.

Four sets of norms were used for comparison at the three, four, five, six, and seven year levels. The first two sets were compiled by Templin (8) in 1957. One set listed the phonemes correctly pronounced by 90% of the children tested at each age level. The second set consisted of those phonemes correctly pronounced by 75% of the children at each age level. The third and fourth sets of norms used were those of Poole (8:20) and Wellman (8:19-20) both of whom used the 75% level of correct articulation as the criterion of normality.

The Wood Articulation Index (Appendix A) was used as the numerical score of articulation effectiveness because only consonants were tested and because, as mentioned in Chapter I, the Wood AI has been found to be as effective as any other numerical score.

Using the Wood AI an expected score was computed for each age level on each of the sets of norms. The values of the sounds normally developed were totaled for each age level and the total of each age level was added to the total of the successive level. Thus, according to Templin's 90% level of correct pronunciation, a three year old will correctly pronounce [m] , [n] , [p] , [h] , and [w] in all positions. Using the Wood AI it was found that [m] has a value of 5.2, [n] 10.4, [p] 2.18, [h] 3.9, and [w] 4.2. These values were added for a total of 26.5. Next, the values for the sounds correctly produced by the four year level were added for a total of 13.2. This was added to 26.5 for the four year level AI of 39.7. This four year level AI of 39.7 was then added on to the five year total of sound values, and the same procedure was followed through the seven year level.

It was decided that a picture articulation test would be the simplest and most efficient method of testing the subjects' articulation. Since the Hejna Developmental Articulation Test (Appendix B) utilizes standard picture cards and provides convenient score sheets, it was used in the next step of the study.

Twenty children at each age level were chosen as subjects for the tests. None of the subjects were bilingual and none had received or been referred for speech correction. The three, four, and five year old subjects were drawn from the Little Bear's School, the Country Garden Preschool, the Boots and Saddle School, and the Iola Frans School nursery school, while the six and seven year old

subjects all were drawn from first grade sections at Iola Frans School. All of these schools are located in Tucson, Arizona.

The Hejna picture cards were presented individually to the subjects in quiet rooms at the schools, and the responses were recorded on the test sheets. Following Hejna's test directions, if a child could not name a picture the name was told to him and he was asked to repeat the name aloud.

The AI'S for each child were computed and the mean scores for each age level were ascertained. These means were then compared with the expected scores based on the four sets of developmental norms. The results of this procedure will be seen in Chapter IV.

CHAPTER IV

PRESENTATION OF THE DATA

The scores at each age level obtained from the four sets of developmental age level norms varied widely among themselves and were far lower than the subjects' actual mean scores. It may be clearly seen in Table II that the only level at which the scores agree somewhat is at the seven year level. This, however, might be expected since the normative studies show a child's sound development to be complete with the exception of two or three sounds at the seven year level.

TABLE II

COMPARISON OF MEAN SCORES OF SUBJECTS WITH EXPECTED SCORES AT EACH LEVEL

	Age 3	Age 4	Age 5	Age 6	Age 7
Subject means	86.6	96.8	96.8	99.3	99.6
Templin 90% level	26.5	39.6	49.5	79.1	96.3
Templin 75% level	32.5	69.7		91.3	100.36
Poole 75% level	19.0	59.1	77.1	76.46	99.56
Wellman 75% level	30.9	49.4	98.8	98.9	

The advisability of a statistical analysis of the data was precluded by the marked deviation in the scores. Such an analysis

obviously would yield no information under the circumstances.

It might be hypothesized that a disagreement in scores such as was found could possibly be accounted for in terms of differences in the procedures of the studies. A review of procedures used, however, revealed that in all the studies the testing procedures were essentially the same.

Templin's (8:6-12) 480 subjects were shown picture cards to be named or repeated after the examiner. The children all were enrolled in either a kindergarten, nursery school, or public school. None were bilingual, and none had received or been referred for speech therapy.

Poole (8:20) used only sixty-five children in her sample. The children were given individual picture articulation tests and if the response was not spontaneous the child was asked to repeat the word after the examiner.

Wellman (8:19-20) administered a picture articulation test individually to 204 children. In this study, however, the word to be elicited was not demonstrated by the examiner if the child failed to respond.

It may be seen from this review of procedures that the only difference in the studies is in the size of the samples. This difference, however, would not seem to be large enough to warrant such a deviation in the scores.

As has been stated, the purpose of this study was to assign numerical articulation score norms to the developmental age levels of

three, four, five, six, and seven according to normative studies which list the age levels at which phonemes appear. However, because of the lack of agreement between the mean scores of the subjects in the present study and the scores computed for the four sets of normative data, the original purpose of this study cannot be accomplished.

CHAPTER V

SUMMARY AND RECOMMENDATIONS FOR FURTHER STUDY

I. SUMMARY

In this study it was pointed out that while the present methods of articulation testing are not incorrect they do not provide all of the information necessary for an accurate appraisal of children's articulatory problems. It was emphasized that two important factors need to be considered in an articulatory analysis. They are (1) that misarticulated sounds which occur frequently in speech constitute a more severe disorder than the misarticulation of a less frequently used sound, and, (2) that sounds are learned by children in an order related to the developmental age level.

The Wood (12), Barker (1), and Shogren (7) studies in the area of frequency of occurrence of sounds were reviewed. The Wood and Barker studies resulted in the formulation of scales of articulation effectiveness based on the numerical values of sounds according to their frequency of occurrence in speech. The Wood Articulation Index considered consonants only while the Barker Articulation Score included vowels. Shogren concluded from her study which compared the Wood and Barker studies that the exclusion of vowels by Wood did not reduce the efficiency of his Index.

The Templin (8), Poole (8:20), and Wellman (8:19-20) studies in the area of developmental age level at which the phonemes appear in a child's speech were also reviewed. All three studies resulted in a list of the phonemes normally acquired at the ages of three, four, five, six, seven, and eight. Hejna's (2) Developmental Articulation Test was based on the results of Templin's study and presented the results of the test in terms of a child's developmental age level.

A review of the literature indicated that while numerical scores of articulation and knowledge of the developmental age level at which phonemes appear give a certain amount of information, a numerical score of articulation effectiveness must be considered in terms of a child's age in order that the score will have a diagnostic value. Therefore, it was concluded that a study was needed to assign articulation score norms to the developmental age levels of three, four, five, six, and seven, by computing numerical scores for each age level according to the norms sited by Templin, Poole, and Wellman, and by comparing these scores to the mean scores actually received by children tested at each level.

The Wood AI was used to assign numerical scores to each age level using the Templin, Poole, and Wellman normative data. Hejna's Developmental Articulation Test was then administered to twenty children at each age level from three to seven. The subjects were drawn from kindergartens, nursery schools, and public schools in the Tucson area. None had received or been referred for speech therapy, and none

were bilingual. The scores for each child were assigned from the Wood AI and the mean scores for each age level were computed. Finally, these mean scores for the subjects were compared with the scores computed for each age level in the developmental normative studies.

The subjects' mean scores were seen to be much higher than those assigned from the normative data, and there was little or no agreement among the scores drawn from the normative studies until the seven year level was reached.

The procedures of the normative studies were reviewed in an attempt to account for the outstanding disagreements in the scores, but no important differences were found.

A statistical analysis of the data was unnecessary since the differences in the scores were obvious and such an analysis would yield no valuable information.

II. RECOMMENDATIONS FOR FURTHER STUDY

From the results of this study it seems reasonable to assume that there is little agreement among normative studies as to the phonemes normally developed at each age level. It may be that further studies in this area will reveal that no strict developmental order exists, but until that time it is recommended that (1) further study be done in this area, and that (2) if it is found that a developmental order does exist then a study should be conducted in which an attempt is made to assign articulatory score norms to the age levels at which phonemes are developed.

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APPENDICES

APPENDIX A

RELATIVE VALUES OF CONSONANT SOUNDS IN THE WOOD ARTICULATION INDEX

Sound	Total Rel. Value	Initial	Medial	Final
p	2.8	.93	.93	.93
b	2.9	.97	.97	.97
m	5.2	1.70	1.70	1.70
t	12.0	4.00	4.00	4.00
d	6.3	2.10	2.10	2.10
n	10.4	3.47	3.47	3.47
k	5.1	1.70	1.70	1.70
g	2.7	.90	.90	.90
ŋ	1.9		.95	.95
s	8.9	2.97	2.97	2.97
ʃ	1.3	.43	.43	.43
ʧ	.7	.23	.23	.23
z	4.3	1.43	1.43	1.43
ʒ	.06		.03	.03
ʤ	.7	.23	.23	.23
f	2.4	.80	.80	.80
v	2.4	.80	.80	.80
ɵ	.9	.30	.30	.30
ð	4.0	1.33	1.33	1.33
l	6.3	2.10	2.10	2.10
r	9.3	3.10	3.10	3.10
j	1.7	.85	.85	
h	3.9	1.95	1.95	
w	4.2	2.10	2.10	
hw	.6	.30	.30	

APPENDIX B

TEST WORDS FOR EACH AGE LEVEL IN HEJNA'S
DEVELOPMENTAL ARTICULATION TEST

Age	Sound	Test Words
3	[m]	monkey, hammer, broom
3	[n]	nails, penny, lion
3	[p]	pig, puppy, cup
3	[h]	house, dog-house
3	[w]	window, spider-web
4	[b]	boat, baby, bib
4	[k]	cat, chicken, book
4	[g]	girl, wagon, pig
4	[f]	fork, telephone, knife
5	[j]	yellow, onion (thank-you; Alt.)
5	[ŋ]	fingers, ring
5	[d]	dog, ladder, bed
6	[l]	lamp, balloon, ball
6	[r]	rabbit, barn, car
6	[t]	table, potatoes, coat
6	[ʃ]	shoe, dishes, fish
6	[ʧ]	chair, matches, watch
7	[v]	vacuum, television, stove
7	[θ]	thumb, toothbrush, teeth
7	[ʤ]	jump-rope, orange-juice, orange
7	[s]	sun, pencil, bus
7	[z]	zebra, scissors, rubbers
8	[ð]	this or that, feathers