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To determine the accuracy with which the 47-item Predictive Screening Test of Articulation (PSTA) is able to identify first grade children who will master their articulation errors without speech therapy by the time they enter third grade, two groups of children were studied who were deficient enough in speech to be enrolled in therapy, but had no anatomic anomaly or were enrolled in special education classes. The basic cross-validation group had 144 children with an average of 6-6 years; the supplementary cross-validation group had 81 children with an average age of 6-7 years. The children were tested in the second month of school in 1965 (first grade), 1966 (second grade), and in 1967 (third grade), and had no therapy during this time. Results indicated that the predictive validity of the PSTA was demonstrated and that, for first grade populations similar to the basic cross-validation group, a cutoff score of 34 is optimally effective in differentiating children who will not require therapy from those who will. A 13-item bibliography, four tables, and the PSTA are included. A preliminary report is included in the ERIC system as ED 010 165. (SN)

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February, 1968

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Office of Education, Bureau of Research

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Kalamazoo, Michigan

February, 1968

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Particular acknowledgment is due Mrs. Mary Ida Hunt who, during the entire tenure of the project which is culminated in the present study, has served carefully and capably as the project examiner.

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SUMMARY

Background

While it is recognized that children's articulation skills often are not matured until age eight or later, the largest proportion of cases treated by the speech clinician in the schools appears to be composed of children who exhibit functional articulation errors and who are enrolled in the primary elementary grades. This situation, in combination with usually excessively large caseloads and concomitant scheduling problems, makes it difficult for the clinician to provide sufficient help for the more severely handicapped child. At the same time, the clinician can ill afford to neglect any child whose articulation problems may only become more strongly habituated if speech therapy is delayed. Unfortunately, there has been no efficient and reliable way to differentiate primary grade children who will master their articulation errors without speech therapy from those who, without therapy, will persist in their errors.

If such a differentiation were possible, more therapy time could be available for the severely handicapped children requiring clinical help. Contacts with parents and classroom teachers might also be facilitated if the time available for these consultations could thus be increased. Dependable early identification of children who definitely will require therapy might also ensure that these children could begin to receive sufficiently intensive help before their articulatory errors are strongly habituated. If the school clinician had greater opportunity to do more effective professional work it is even possible that unity would be enhanced within a profession which shows signs of schism between clinicians in the schools and those in other settings. The development, then, of a valid and reliable prognostic articulation test--in addition to improving the services afforded individual children--could have far reaching implications for the entire speech and hearing profession.

In a previous study supported by the Office of Education of the U. S. Department of Health, Education and Welfare (Cooperative Research Project No. 1538), a 47-item Predictive Screening Test of Articulation was constructed which appeared able to predict a first grader's acquisition of (or his failure to acquire) normal articulation by the time he reached third grade. It remained to be demonstrated at the conclusion of this earlier study, however, that the test would function as well in a population of first grade children other than those upon whose responses the initial test construction actually was based.

Objective

The objective of the present study was to determine the accuracy with which the Predictive Screening Test of Articulation (PSTA) is able (in a population other than that used for the empirical derivation

of test items) to identify first grade children who will master their articulation errors without speech therapy by the time they enter third grade.

Procedure

The PSTA was administered in September and October of 1965 to 180 first grade children in Calhoun and Shiawassee Counties in Michigan (Group 1) and to 113 first grade children in Tuscola County, Michigan (Group 2). All children in both groups were judged by trained speech clinicians to have functional misarticulations in their speech. For Group 1, the basic cross-validation group, the PSTA administration and the subsequent articulation re-checks in 1966 and 1967 were conducted by the project examiner. In Group 2, a supplementary cross-validation group, these tasks were accomplished by state certified speech clinicians in the local schools. No child in either group received any speech therapy prior to the final evaluation of his articulatory skills at the beginning of his third grade year in school.

PSTA score distributions for both groups were analyzed with specific reference to differences between the scores of children who demonstrated normal articulation in the third grade and the scores of those who continued to have articulation errors at that time. In addition, PSTA score distributions were obtained as a first step in providing additional normative data regarding PSTA performances at the kindergarten and first grade levels.

Conclusions and Recommendations

From the results of this study it can be concluded that the predictive validity of the Predictive Screening Test of Articulation has been demonstrated and that, for first grade populations similar to Group 1 in the present study, a PSTA cut-off score of 34 is optimally effective in differentiating children who will not require therapy from those whose functional misarticulations, without therapy, will persist into the third grade.

The results also permit the following observations. Among children who present functional misarticulations at the first grade level, approximately 25 per cent may be expected to have normal articulation by the beginning of the second grade. Few, if any, of those children with normal articulation will have obtained PSTA scores lower than 25 as first graders. By the time children reach the third grade, approximately 50 per cent of those who had functional misarticulations as first graders will have normal articulation.

Before any of the possible PSTA cut-off scores are employed to select cases from a given population, it is strongly recommended that the clinician determine the equivalence of that population to the population which was designated as Group 1 in the present study.

INTRODUCTION

Background of the Problem

A number of writers have presented evidence that with increases in chronological age, at least until the age of eight years, a normal and spontaneous decrease can be observed in the number of speech sounds which children misarticulate (4, 6, 8, 11). Studies of the articulatory skills of children in elementary schools where speech therapy was not available also have demonstrated that the incidence of misarticulations is progressively and significantly reduced as children move from one primary grade level to the next (3, 7). One of the present writers has reported that of 134 children who presented functional misarticulations at the beginning of the first grade, 63 (or 47 per cent) had acquired normal articulation without speech therapy by the time they reached third grade (13).

While it generally is recognized, then, that children's articulation skills often are not matured until age eight or later, it also has been reported that 75 per cent of the children enrolled in the caseloads of public school speech clinicians are in the kindergarten or the first or second grades and that 81 per cent of these children possess functionally defective articulation (5). This situation, in combination with usually excessively large caseloads and concomitant scheduling problems, makes it difficult for the clinician to provide the intensive and individual help often required by the more severely handicapped child. The school speech clinician, as well as the children he serves, could profit in a number of ways if it were possible to differentiate, efficiently and reliably, primary grad children who will master their articulation errors without speech therapy from those who, without therapy, will persist in their errors.

If those children who will master their speech sounds without assistance could be eliminated from therapy, more time would be available for those children with more severe communication handicaps. Contacts with parents and classroom teachers might also be facilitated if the time available for these consultations could thus be increased. Dependable early identification of children who definitely will require therapy also might ensure that these children could begin to receive sufficiently intensive help before their articulatory errors are strongly habituated. If the school clinician had this greater opportunity to do more effective professional work it even is possible that unity would be enhanced within a profession which shows signs of schism between clinicians in the schools and those in other employment settings. It is apparent, then, that a valid and reliable prognostic articulation test--in addition to improving the services afforded individual children--could have far reaching implications for the entire speech and hearing profession. Unfortunately, no test of this type has been available; in fact, there has been no standardized technique for the differentiation of primary grade children who will master their articulation errors without speech therapy from those who will not.

Related Literature

Several studies have suggested possible bases for the construction of a useful prognostic test. Snow and Milisen (9) elicited marked improvement in the articulation of some children following brief stimulation and speculated that a carefully designed oral and visual stimulation test might have prognostic value. Carter and Buck (1) found first grade children who were able to correct 75 per cent of their errors on a picture naming test when they used these same sounds in nonsense syllables and suggested that such children should be excluded from speech therapy until the end of second grade. Steer and Drexler (10) found that the total number of articulation errors, the position of the error within the word, and the type of error all were indices with some value in predicting the later articulation skills of kindergarten children. In another study concerned with predicting changes in the articulation of kindergarten children, Farquhar (2) reported that the ability to imitate the examiner's correct production of the child's misarticulated sounds appeared related to subsequent improvement. Few, if any, data are available, however, to demonstrate either the reliability or the validity of these techniques.

In 1962 Van Riper incorporated a number of these and other types of suggested prognostic techniques in a battery of test items from which a 47-item Predictive Screening Test of Articulation (PSTA) eventually was empirically derived. By surveying available literature and interviewing experienced speech therapists, he compiled a pool of 500 test items suggested as having possible prognostic value. This pool was then reduced to 200 items which, on further inspection, appeared best to meet certain criteria regarding ease of administration, objectivity and simplicity of scoring, and appropriateness to the first grade age level. A pilot adminstration of these items to first grade children by selected therapists led to the elimination of 65 more items which proved unreliable or which were judged by these therapists as being too difficult or time consuming in administration.

Of the remaining 135 items, 111 items were direct tests of some behavior in the child and were items to which a child's response might relatively easily be classified either as passing or failing. The other 24 items of the Experimental Item Pool were retained primarily for their possible value in supplementing and/or synthesizing results obtained with the basic 111 items. These 24 items, among other things, required the examiner to record information about such factors as: the child's speaking rate; his cooperativeness in the testing situation; his voice quality; his number of siblings; subjective impressions of the child's intelligence; and certain compilations and summations of responses observed in the other 111 items.

This entire Experimental Item Pool then was administered, by a single examiner, to 167 beginning first-grade children within a two-month period during the fall of 1962. Each of these children had been judged by a state certified public school speech therapist to have functionally defective articulation which was sufficiently deviant to

warrant enrollment in a speech therapy program. It was arranged that none of these children would receive speech therapy during the ensuing two years.

During a two-month period in the fall of 1963, when the subjects of this study were beginning the second grade, each available child was rechecked by the trained project examiner by means of a simple phonetic inventory and by the elicitation of samples of spontaneous connected speech. On the basis of these observations each subject was classified as a member either of the "Still Defective Group" or of the "Normal Articulation Group". Similarly, in the fall of 1964 those subjects still available at the third grade level were again re-examined and reclassified in the manner described above.

On the bases of the second and third grade dichotomizations ("Still defective" versus "normal" articulation), item analyses were performed over each of the basic 111 items to identify those items which differentiated: (1) between first graders with defective articulation who had acquired normal articulation within one year and those who had not; and (2) between those who had acquired normal articulation within two years and those who had not.

The response record sheet of each subject was scored individually with the keys derived empirically in this manner, and the resultant frequency distributions of scores were analyzed with particular reference to the establishment of possible cut-off scores.

The speech evaluations conducted during the second year of this project indicated that 25 per cent of the subjects had spontaneously mastered normal articulation during the interval between the beginning of the first grade and the beginning of the second grade, while 75 per cent of the subjects continued to exhibit articulatory errors. The speech evaluations conducted during the third year of this project indicated that 47 per cent of the subjects had spontaneously mastered normal articulation during the interval between the beginning of the first grade and the beginning of the third grade, while only 53 per cent continued to exhibit articulatory errors.

Finally, a selected 47-item Experimental Form of the Predictive Screening Test of Articulation was derived which appeared able to predict a first grader's acquisition of normal articulation by the time he reaches third grade. The compilation of Van Riper's initial item pool and the procedures employed to eliminate those items which showed no significant prognostic value are described elsewhere in detail (13).

The PSTA appeared potentially to be a useful instrument with which to differentiate first-grade children who, by the time they reach third grade, will overcome their articulatory errors without speech therapy from those children who will not. Moreover, the test was relatively easy to administer in a standardized fashion; it involved only a simple dichotomous judgment for scoring each item; and the time required to administer and score the entire test ranged from only five to ten minutes. It remained yet to be demonstrated at the conclusion of this

earlier study, however, that the test would function equally well in a population of first grade children other than those upon whose responses the initial test derivation actually was based.

Objectives

The major objective of the present study was to determine the accuracy with which the PSTA is able--in a population other than that used for the derivation of test items--to identify first grade children who will master their articulation errors without speech therapy by the time they enter third grade. Corollary to this, of course, was the necessity of determining the accuracy with which the test will identify those children who will not overcome their errors in the same time period.

PROCEDURES

The Predictive Screening Test of Articulation (Appendix A contains the PSTA Instruction Manual and Response Record Sheet) was administered during September and October of 1965 to a total cross-validation population of 293 first-grade elementary school children.

Subjects

Group 1 was comprised initially of 180 children from Calhoun and Shiawasee Counties in Michigan whose articulation was judged by a state certified speech clinician to be sufficiently defective to warrant enrollment in a state reimbursed therapy program. No child was included whose articulatory deviation appeared relatable to any anatomic anomaly, or who was enrolled in any form of special education classroom. No child was included, either, who was known to have a clinically significant hearing loss. In order to permit their inclusion in this study, it was arranged that none of these children would receive speech therapy services during the ensuing two years. The average age of children in this group was six-years, six-months.

Group 2 was composed initially of 113 children from Tuscola County, Michigan, all of whom met the same selection criteria as did the members of Group 1. The average age of children in Group 2 was six-years, seven-months.

Second and Third Grade Articulation Assessments

During a two-month period in the fall of 1966, when the subjects of this study were beginning the second grade, each available child (22 subjects from Group 1 and 18 subjects from Group 2 had moved or were otherwise inaccessible) was rechecked by means of a simple phonetic inventory and by the elicitation of samples of spontaneous connected speech. On the basis of these observations each child was classified as a member either of the "Still Defective Group" or of the "Normal Articulation Group." Similarly, in the fall of 1967 those subjects still available at the third grade level (an additional 14 subjects from Group 1 and an additional 14 subjects from Group 2 were lost in this interval) were again re-examined and reclassified in the manner described above.

Examiners

The administration of the PSTA as well as each of the two articulation re-checks was accomplished, in the case of each subject in Group 1, by an experienced speech clinician who was trained specifically and who had had extensive experience in the administration of the test items. For Group 2 these tasks were accomplished by state certified speech clinicians in the local schools.

Supplementary Normative Data

During the fall of 1967, the PSTA was administered to a population of 2093 Tacoma, Washington children regarded as possessing normal hearing and no organic handicap, and who were not and never had been enrolled in speech therapy. Of these children, all of whom were members of regular classrooms, 1122 were enrolled in kindergarten and 971 were enrolled in first grade. The selection of subjects and the administration and scoring of the PSTA in these groups were accomplished by speech clinicians employed by the Tacoma public school system.

Treatment of the Data

Distributions of PSTA scores were analyzed with specific references to differences between the scores of children who demonstrated normal articulation in the third grade and the scores of those who continued to have articulation errors at that time and--for reasons which are discussed later--with specific reference to the cross-validation subjects of Group 1.

Because many PSTA items replicate items which appear in the Templin-Darley Screening Test of Articulation (12), distributions of scores on a scale keyed only to those items common to both instruments also were prepared.

Finally, separate frequency distributions of PSTA scores were prepared for normal speaking boys and normal speaking girls at both the kindergarten and first grade levels.

RESULTS AND DISCUSSION

As mentioned earlier, there was a relatively high rate of attrition in the two cross-validation populations. Group 1 began with 180 subjects; one year later only 158 subjects were available for articulation rechecks; and in the final phase, as subjects began the third grade, 144 (or 80 per cent) of the Group 1 subjects were accessible. In the beginning Group 2 numbered 113 subjects; in the second year, 95 subjects; and in the third year 81 subjects (72 per cent of the original population) continued to be available. While both attrition rates do seem high, the rate among Group 1 subjects was identical to that observed from 1962 to 1964 in the original population of subjects employed in the construction of the PSTA (13); thus, Group 1 conforms more closely than does Group 2 to the attrition rate anticipated on the basis of earlier experience.

With reference to those 225 subjects who were available for the entire two year period of this cross-validation project, another interesting difference existed between Group 1 and Group 2. An analysis of the numbers of phonemes misarticulated by individual members of the two groups as first-graders led to the following observations. In Group 1 the number of phonemes misarticulated ranged from one to nine, the mean number was 2.2, and the median was two. In Group 2 the number of phonemes misarticulated ranged also from one to nine, but the mean was 3.1, and the median was three. Closer inspection of these particular data revealed that 39 per cent of the members of Group 1 misarticulated only one phoneme, whereas only 19 per cent of Group 2 misarticulated as few as one phoneme. In Group 1, 71 per cent misarticulated two or fewer phonemes, and 87 per cent misarticulated three or fewer. In Group 2, the corresponding figures were 47 per cent and 68 per cent. It is apparent, then, that in terms of these bases for comparison the two groups were quite dissimilar in composition. The reasons for this disparity are not immediately clear, but certain implications of i are discussed in later sections.

In view of the differences cited above, it was decided that the two cross-validation groups should be considered separately and that those data from Group 1 should provide the primary basis for subsequent analyses of PSTA results. The 144 subjects of Group 1 who were continuously available for this study, then, comprise the basic cross-validation population.

PSTA Scores in Original Cross-Validation Groups

Among the 180 subjects who began in Group 1 the range of PSTA scores was from 13 to 46; the median was 33; the mean, 32.81; and the standard deviation was 7.83. The scores of the 113 original subjects in Group 2 ranged from 4 to 47; the median was 30, the mean, 30.96; the standard deviation, 6.34. The difference between these means is significant at the five per cent level of confidence ($t=2.05$) and tends further to confirm the previously noted inadvisability of combining the data from the two groups.

PSTA Reliability

As reported earlier (13, p. 25), a product-moment correlation coefficient of .81 was obtained between the scores of the 293 first-grade cross-validation subjects on two randomly selected halves of the 47-item test. The reliability coefficient, as estimated by means of the Spearman-Brown formula, is .895.

Second Grade Reevaluations

Group 1. Of the 158 subjects available at the beginning of second grade, 39 (or 25 per cent) no longer exhibited any misarticulations. This proportion, incidentally, is the same as that observed in the first phase of the PSTA project (13). The range of PSTA scores in Group 1 was from 13 to 46; the median was 33; and the mean was 32.61. The similarity of these scores to those observed in the original group of 180 subjects suggests that no systematic bias was introduced by the loss of 22 subjects. Among the 39 children presenting normal articulation, the initial range of PSTA scores had been from 25 to 45; the median, 39; and the mean, 37.28. Among those 119 children who still possessed misarticulations, PSTA scores had ranged from 13 to 46, with a median of 32 and a mean of 31.29. With reference to the Group 1 median score of 33, it was observed that 28 (or 72 per cent) of the children judged to have normal articulation had received scores equal to or higher than the group median. It was also true, however, that 56 (or 47 per cent) of the children who continued to evidence misarticulations received scores equal to or higher than the group median. No child who initially had obtained a PSTA score of 24 or less was observed to be free of misarticulations by the time he reached second grade; but confounding the possibility of employing the score of 25 as a "cut-off" score, of course, is the fact that (as may be seen in Appendix B) 98 of the 119 children with misarticulations also had scored 25 or more points on the PSTA. Of the 137 Group 1 children who, as first-graders, had received PSTA scores of 25 or more, then, approximately 72 per cent continued to present misarticulations at the second grade level.

Group 2. Of the 95 children now available in this group, 21 (or 22 per cent) no longer were classified as having any misarticulations in their speech. This proportion is somewhat lower than that in Group 1; but, in terms of other noted differences between the two groups, this tendency toward relatively greater persistence of misarticulations in Group 2 seems entirely reasonable. As shown in Appendix B, the range of PSTA scores in Group 2 was from 4 to 47; the median was 31; and the mean was 30.47. As in the case of Group 1, there is no reason to assume that the composition of this group differs in any substantial or systematic way from the 113 original Group 2 subjects. Among the 21 children who had normal articulation at the second grade level, the range of PSTA scores was from 25 to 47; the median, 36; the mean, 35.80. For the remaining 74 children of Group 2 the range was from 4 to 47; the median, 29; and the mean, 28.75. It is of interest to note that, as in Group 1, no child whose PSTA score was 24 or lower was free of

misarticulations at the beginning of second grade. Of the 74 Group 2 children who had obtained PSTA scores of 25 or higher, though, approximately 72 per cent--just as in Group 1--continued to have misarticulations at the second grade level. With reference to the median score for Group 2, 71 per cent of the Group 2 children with normal articulation had received scores of 31 or greater, while 45 per cent of the children who continued to have misarticulations had received scores equal to or greater than 31.

Third Grade Reevaluations

Group 1. Of the 144 subjects still available at the beginning of the third grade, 70 (or 49 per cent) were classified as being free of any misarticulations, while 74 (or 51 per cent) continued to demonstrate some misarticulations in their speech. The range of PSTA scores for all 144 subjects was from 13 to 46; the median was 33; the mean was 32.67; and the standard deviation was 7.80. Again, subject attrition did not seem to have occurred in any systematic fashion. For those who now had normal articulation the PSTA scores ranged from 13 to 46 with a median of 37, a mean of 35.66, and a standard deviation of 6.92. The PSTA scores of those whose misarticulations had persisted ranged from 13 to 43 with a median of 31, a mean of 29.84, and a standard deviation of 7.52. The frequency, cumulative frequency, and relative cumulative frequency of these scores are presented in Table 1.

Group 2. At the beginning of the third grade 81 of the original 113 members of this group were available for articulation rechecks. The PSTA scores of these 81 subjects ranged from 4 to 47 with a median score of 31, a mean of 30.59, and a standard deviation of 8.35. These scores are quite comparable to those of the original 113 member group. In Group 2 there were 39 children with normal articulation in the third grade (36 per cent of the group) and 52 (or 64 per cent) who continued to have misarticulated sounds. The PSTA scores in the former group (as shown in Table 2) ranged from 20 to 47; the median was 35, the mean was 35.03, and the standard deviation was 6.14. The children who continued to present misarticulations ranged in their PSTA scores from 4 to 42 with a median score of 28, a mean of 28.12, and a standard deviation of 8.37.

Articulation differences. It does not appear that a simple count of the number of phonemes misarticulated at the first grade level would have provided significant predictive information for the present groups. Among the 70 children of Group 1 who had normal articulation by the time they began third grade, the number of phonemes misarticulated as first-graders had ranged from one to six with a median of two and a mean of 1.91. The range among the remaining 74 children was from one to nine with a median of two and a mean of 2.5. Comparable figures for Group 2 were: range, one to five; median, 2; mean, 2.2; and range, one to nine; median, 3; mean, 3.6, respectively. As might be expected, the earlier noted dissimilarity between Group 1 and Group 2 is reflected here especially in terms of those subjects whose misarticulations continued to be present at the third grade level.

Table 1. Frequency (f), cumulative frequency (cf) and cumulative relative frequency (crf) distributions of scores obtained on the Second Experimental Form of the PSTA by Group 1 children who continued to have defective articulation at the third grade level and by those who demonstrated normal articulation at the third grade level.

	Still Defective Group (n=74)			Normal Articulation Group (n=70)		
Score	f	cf	crf	f	cf	crf
46				1	70	1.00
45				2	69	.99
44				6	67	.96
43	1	74	1.00	6	61	.87
42	1	73	.99	4	55	.79
41	2	72	.97	1	51	.73
40	2	70	.95	5	50	.71
39	5	68	.92	4	45	.64
38	3	63	.85	5	41	.59
37	2	60	.81	2	36	.51
36	1	58	.78	3	34	.49
35	3	57	.77	3	31	.44
34	2	54	.73	2	28	.40
33	7	52	.70	2	26	.37
32	5	45	.61	1	24	.34
31	4	40	.54	5	23	.33
30	7	36	.49	3	18	.26
29	1	29	.39	4	15	.21
28	5	28	.38	1	11	.16
27	2	23	.31	4	10	.14
26	2	21	.28	0	6	.09
25	3	19	.26	2	6	.09
24	2	16	.22	1	4	.06
23	1	14	.19	2	3	.04
22	1	13	.18	0	1	.01
21	1	12	.16	0	1	.01
20	1	11	.15	0	1	.01
19	0	10	.14	0	1	.01
18	3	10	.14	0	1	.01
17	2	7	.09	0	1	.01
16	2	5	.07	0	1	.01
15	0	3	.04	0	1	.01
14	1	3	.04	0	1	.01
13	2	2	.03	1	1	.01
12	0	0	.00	0	0	.00

Table 2. Frequency (f), cumulative frequency (cf) and cumulative relative frequency (crf) distributions of scores obtained on the Second Experimental Form of the PSTA by Group 2 children who continued to have defective articulation at the third grade level and by those who demonstrated normal articulation at the third grade level.

Score	Still Defective Group (n=52)			Normal Articulation Group (n=29)		
	f	cf	crf	f	cf	crf
47				1	29	1.00
46				0	28	.97
45				1	28	.97
44				1	27	.93
43				1	26	.90
42	2	52	1.00	0	25	.86
41	1	50	.96	3	25	.86
40	3	49	.94	1	22	.76
39	2	46	.88	1	21	.72
38	1	44	.85	1	20	.69
37	1	43	.83	0	19	.66
36	0	42	.81	2	19	.66
35	2	42	.81	4	17	.59
34	2	40	.77	0	13	.45
33	1	38	.73	4	13	.45
32	2	37	.71	0	9	.31
31	3	35	.67	3	9	.31
30	2	32	.62	0	6	.21
29	3	30	.58	3	6	.21
28	2	27	.52	1	3	.10
27	5	25	.48	0	2	.07
26	3	20	.38	0	2	.07
25	2	17	.33	1	2	.07
24	1	15	.29	0	1	.03
23	1	14	.27	0	1	.03
22	2	13	.25	0	1	.03
21	3	11	.21	0	1	.03
20	0	8	.15	1	1	.03
19	3	8	.15	0	0	.00
18	1	5	.10			
17	1	4	.08			
16	0	3	.06			
15	0	3	.06			
14	0	3	.06			
13	0	3	.06			
12	0	3	.06			
11	0	3	.06			
10	2	3	.06			
9	0	1	.02			
8	0	1	.02			
7	0	1	.02			
6	0	1	.02			
5	0	1	.02			
4	1	1	.02			
3	0	0	.00			

Sex comparisons. Because girls often have been reported to acquire mature articulation skills more rapidly than do boys, it was deemed advisable to investigate the possible existence of a sex differential in the present cross-validation populations. In Group 1, of the 70 subjects without misarticulations 44 were boys and 26 were girls. The subjects who continued to have misarticulations included 51 boys and 23 girls. In Group 2 there were 15 boys and 14 girls with normal articulation, 24 boys and 18 girls whose misarticulations had persisted. A separate frequency chi-square was computed for each of the two groups, with resultant values of .589 and 1.108, respectively. A chi-square value of 3.481 is required for significance at the five per cent level of confidence. The operation of a sex differential in the spontaneous acquisition of normal articulation cannot be demonstrated, then, in either of the two groups in this study.

Individual Item Responses. It was not proposed that any items be eliminated from the PSTA in this final stage on the basis of any statistical item analysis. It is of interest, nevertheless, to be able to examine the individual item response tendencies for each of the groups studied to date. For this purpose, in Appendix C are compiled the proportions of passing responses to each of the 47 PSTA test items for each of the two present groups (dichotomized on the basis of third grade articulation classification) as well as for the group originally studied by Van Riper (13). The greatest value of these particular data may lie simply in their availability to investigators doing future studies with the PSTA. For the present, it can be observed that a great deal of variation exists with respect to the differences in passing responses reported both within and among the three populations. Although some of the differences in relative frequency of passing responses between "still defective" and "normal articulation" subjects within the two cross-validation groups are too small to be statistically significant, this fact in no way negates the assumption that those items have prognostic value. Probabilities in this situation would be multiplicative, and in the case of all but two items (Item No. 47 which requires the child to replicate a rhythmic handclap; and Item 46, which involves recognition of an error) the difference always is in favor of the "normal articulation" subjects. The single reversal on Item 47 reflects a difference which is low and nonsignificant (t=.35), and it is reasonable to assume that it represents a chance occurrence. On Item 46 there is one group in which no difference was observed in either direction.

On certain items differences between "defective" and "normal" articulators within <u>each</u> group did reach a magnitude required for statistical significance at or beyond the five per cent level of confidence. The foregoing criterion was met by each of the following seven items: items 2 and 3 (which require the child to repeat "soap" and "leaf", respectively, following three stimulus presentations by the examiner); items 19, 21, and 35 (which require the child to repeat "bread", "grass", and "dress", respectively, following one stimulus presentation by the examiner); and items 42 and 43 (which require that

the child repeat "seeseesee" and "zoozoozoo", respectively, following one stimulus presentation by the examiner). See Appendix A for the scoring criteria employed with these and the other items of the PSTA.

PSTA Cut-off Scores

The nature of the many differences observed between Group 1 and Group 2 suggests that the effects of cut-off scores based on the data from Group 1 may be generalized more readily than would be true if Group 2 data were employed or if the data from both groups were combined. The extent to which these inter-group differences represent true differences between the actual available populations of first-graders with functional misarticulations--as opposed to chance differences or to systematic differences in selection procedures--is indeterminate and, in the present context, irrelevant. It should be stressed, however, that the appropriateness of applying any specific cut-off score discussed below will be a function of the degree in which the population in question resembles the population represented by Group 1 in this study.

In terms of possible cut-off scores, of course, any decision must be based to some extent on *a priori* assumptions regarding the relative seriousness of the two types of error which necessarily arise at any reasonable cut-off level in a score distribution where overlap occurs between the groups one wishes to differentiate. This overlapping in PSTA scores can be studied closely in Table 1. Nearly half of the "still defective" group, for example, obtained scores of 30 or less; at the same time, about one-fourth of the "normal" group also obtained scores of 30 or less. Conversely, about three-quarters of the "normal" group obviously received scores of 31 or higher; but so did one-half of the "still defective" group. Of the children whose articulation was normal in the third grade, 63 per cent received PSTA scores which were higher than the Group 1 median of 33; among those children who continued to have misarticulations, 28 per cent received PSTA scores which were higher than the Group 1 median of 33; Overlapping between these two groups can be analyzed in a variety of ways, and the overlap at different levels is of critical significance in the selection of a cut-off score.

If one wishes to maximize the probability of identifying for therapy those children who will not have normal articulation by the third grade, a relatively high cut-off score must be used. In the extreme, for example, if it were specified that all children who receive scores of 43 or lower should be included in therapy, all members of the "still defective" group would be included. Such a procedure, as is obvious from Table 1, also would lead to the initiation of therapy for some 87 per cent of those children who do not require professional help. The utilization of an extremely high cut-off score, then, would offer little advantage over a case selection procedure which simply included in therapy all first-graders with functional misarticulations. The use of an extremely low cut-off score, for reasons which should be

apparent, would be equally undesirable--although the type of error introduced would be different. Here the effect would be one of excluding from therapy virtually all first-graders. Errors of the first type--indentifying children as needing therapy who in fact do not--will be referred to as "false positive errors." Errors of the second type--excluding from therapy children who will need help--will be referred to as "false negative errors."

Among the possible undesirable consequences associated with false positive errors, the following are most obvious: (a) the amount of therapy time available for more severely handicapped children may not be increased appreciably, since the clinician's caseload may be reduced but little; and (b) some misarticulations which might otherwise have been overcome spontaneously may conceivably become stabilized through premature efforts at correction. Misarticulations which might easily be corrected in therapy at the first grade level, however, may become habituated and more difficult to correct at a later age if a preponderance of false negative errors occur in case selection.

Optimal Cut-off Score

In our present state of professional knowledge, and in the absence of evidence to the contrary, it would seem most reasonable to select a cut-off score which would yield approximately equally small degrees of both types of errors. With reference again to Group 1 in Table 1, it can be seen that a cut-off score of 34 would best meet this criterion. If all cases who score 33 or less on the PSTA are included in therapy and those who score 34 or more are excluded from therapy, we will have included 70 per cent of those children whose misarticulations will persist into the third grade without therapy. We also will have excluded from therapy 63 per cent of those children who, without therapy, will have normal articulation in the third grade. Other cut-off scores may yield the same total amount of error, but at no other cut-off score will the two types of error be as nearly equal as they are when the score of 34 is used. Even in Group 2, as may be seen in Table 2, a cut-off score of 34 would be defensible. Here it would include 73 per cent of the children in therapy who appear to require therapy, and it would exclude from therapy 55 per cent of those who did not require therapy. In Group 2, however, false negative errors could be decreased with no increase in false positive errors if a cut-off score of 35 were employed. Again, it should be reiterated that the appropriateness of the recommended cut-off score of 34 (or of any other cut-off score) must be judged with reference to the degree in which Group 1 is representative of the population in which that cut-off score is to be employed.

In any event, exclusion from therapy at the first grade level on the basis of any particular PSTA score does not imply unequivocal exclusion from any further consideration of therapy. A certain proportion of the excluded children obviously may need to be enrolled in therapy during the third grade regardless of the cut-off score employed. For

this reason, and because special circumstances under which a given clinician may function can dictate other types of considerations, specifications regarding the effects of a number of possible cut-off scores are presented in Table 3. This table should be read in the following manner. If a cut-off score of 39 is employed, for example, (that is, if only children who score 38 or less are included in therapy) 72 per cent of the children tested will be classed as requiring therapy; 59 per cent of the children who would not have required therapy will, nevertheless, be included in therapy; and 15 per cent of the children who still will have misarticulations in third grade will have been excluded from therapy. There is another way in which the information in Table 3 might also be applied. Assume that a school clinician is able to see that utilization of a cut-off score of 31 will help him to select the 37 per cent who, on the basis of PSTA scores, appear most likely to require therapy. The third and fourth columns in Table 3 will help him to anticipate both the type and the degree of error entailed by this caseload selection procedure.

In practice, the final selection of a cut-off score will vary with the needs and orientation of the clinician as well as with the nature of his program. A clinician who wished to exclude from therapy, for example, only those children virtually certain to demonstrate spontaneous acquisition of normal articulation by third grade might well prefer to use a relatively high cut-off score. A clinician who is able to include only a more limited number of first grade children in his caseload, on the other hand, may wish to employ a cut-off score which is so low that there is virtually no chance that he will be devoting therapy time to a child who may not have required this attention. It should be obvious, of course, that the clinician who wishes to predict the acquisition of normal articulation by second grade (instead of third grade) or who wishes to employ the PSTA at grade levels other than the first grade could not expect the present cut-off scores to provide appropriate indices for his purposes. It is inevitable that no one cut-off score will be universally applicable; and no clinician should conclude that the recommended cut-off score of 34 is the optimal one for him unless and until he has found it to be of value in his own situation.

Templin-Darley Items

The stimulus words for PSTA items 6 through 38 are words which also appear among those used in the Templin-Darley Screening Test of Articulation (12). These words are listed below. The number in front of each word refers to its item number in the PSTA; the number following each word indicates its location in the Templin-Darley Screening Test. That portion of each word is underlined which represents the phoneme or phonemes being tested. During the administration of the PSTA, each of these words must be repeated by the child following only one stimulus presentation by the examiner. During administration of the Templin-Darley Screening Test, however, the word either is elicited spontaneously from the child through the presentation of pictures and

Table 3. Of all first graders with functional misarticulations, total proportion classified as requiring speech therapy; proportion misclassified as requiring speech therapy (false positive errors); and proportion misclassified as requiring no speech therapy (false negative errors) -- when these classifications are based on PSTA scores.

Cut-off Score	Proportion Classified as Requiring Therapy	False Positive Errors	False Negative Errors
39	.72	.59	.15
38	.67	.51	.19
37	.64	.49	.22
36	.61	.44	.23
35	.57	.40	.27
34	.54	.37	.30
33	.48	.34	.39
32	.44	.33	.46
31	.37	.26	.51
30	.31	.21	.61

verbal cues or, as a second resort, it may be elicited in an imitative manner similar to that employed in the PSTA. To whatever extent it may be true that a young child's imitative and spontaneous responses tend to be essentially identical (12), than a "partial" PSTA score may be derived from the responses of a child who has been tested with the Templin-Darley Screening Test. Similarly, of course, the process might be reversed.

6 valentine 31	17 engine 43	28 spider 97
7 teeth 32	18 presents 44	29 stairs 98
8 smooth 33	19 bread 45	30 sky 99
9 arrow 28	20 crayons 48	31 sweeping 101
10 bathtub 32	21 grass 49	32 plant 76
11 sheep 36	22 frog 50	33 shredded wheat 52
12 dishes 36	23 three 51	34 tree 46
13 chair 42	24 clown 78	35 dress 47
14 matches 42	25 flower 80	36 sled 100
15 watch 42	26 smoke 95	37 splash 120
16 jar 43	27 snake 96	38 string 122

Table 4 shows the frequency and cumulative frequency distributions of scores obtained in Group 1 and Group 2 when only those 33 items common to both instruments are scored. These data are presented for information purposes only, however, and it is not suggested that scores obtained on this scale are acceptable surrogates for scores obtained on the full PSTA administered in the prescribed manner. Neither is there any basis, of course, for projecting full 50-item Templin-Darley Screening Test scores by extrapolation from scores on these items. It is possible, nevertheless, that a shortened version of the PSTA which includes only these 33 items could prove to be of value to a clinician who regularly employs the Templin-Darley--especially if he administers this latter test in a manner which elicits imitative responses from the child.

Kindergarten and First Grade Scores

"Normative" PSTA score distributions for 1,122 kindergarten children (531 girls and 591 boys) and for 971 first-graders (487 girls and 484 boys) are presented in Appendix D and Appendix E, respectively. In the Tacoma, Washington Public School classes sampled, the only children excluded from PSTA testing were those who had known hearing losses or obviously handicapping organic disorders or who either previously or at the time of testing were recipients of speech therapy.

The median scores among first-graders (44 for boys, 45 for girls) are slightly higher than those among kindergarten children (41 for boys, 43 for girls); and, of course, the score distribution at the kindergarten level is somewhat less skewed toward low scores than is the first grade distribution. Overall, though, the apparent lack of any marked difference between these two groups tends to suggest that the PSTA might eventually prove to be a useful instrument at the kindergarten level also. Any specific interpretation of PSTA scores among

Table 4. Frequency (f) and cumulative frequency (cf) distributions of scores obtained on 33 items common to the PSTA and the Templin-Darley Screening Test of Articulation by Group 1 and Group 2 children who continued to have defective articulation at the third grade level and by those who demonstrated normal articulation at the third grade level.

	Group 1				Group 2			
	Still Defective (n = 74)		Normal (n = 70)		Still Defective (n = 52)		Normal (n = 29)	
Score	f	cf	f	cf	f	cf	f	cf
33			2	70			2	29
32	3	74	3	68			1	27
31	0	71	8	65			0	26
30	3	71	10	57	2	52	2	26
29	3	68	5	47	2	50	2	24
28	3	65	4	42	2	48	2	22
27	5	62	4	38	1	46	4	20
26	4	57	3	34	4	45	2	16
25	7	53	2	31	1	41	2	14
24	6	46	5	29	6	40	2	12
23	4	40	6	24	4	34	2	10
22	6	36	3	18	3	30	2	8
21	4	30	2	15	4	27	1	6
20	5	26	4	13	0	23	2	5
19	3	21	0	9	4	23	2	3
18	2	18	2	9	3	19	0	1
17	3	16	3	7	3	16	0	1
16	0	13	2	4	3	13	0	1
15	1	13	0	2	3	10	1	1
14	3	12	1	2	0	7		
13	0	9	0	1	2	7		
12	1	9	0	1	1	5		
11	3	8	0	1	0	4		
10	1	5	0	1	1	4		
9	2	4	0	1	0	3		
8	1	2	0	1	0	3		
7	0	1	1	1	1	3		
6	0	1			1	2		
5	1	1			0	1		
4					0	1		
3					0	1		
2					0	1		
1					1	1		

kindergarten children obviously would not be justifiable, it should be emphasized, until subsequent studies have been able to establish a cut-off score with demonstrated predictive validity at the kindergarten level.

CONCLUSIONS AND RECOMMENDATIONS

From the results of this study it can be concluded that the predictive validity of the Predictive Screening Test of Articulation has been demonstrated and that, for first grade populations similar to Group 1 in the present study, a PSTA cut-off score of 34 is optimally effective in differentiating children who will not require therapy from those whose functional misarticulations, without therapy, will persist into the third grade. Through the use of this instrument and the appropriate cut-off score the clinician can expect to identify approximately 63 per cent of those first-graders who will not require therapy in order to be free of articulation errors in two years and 70 per cent of those first-graders who will continue to have misarticulations for at least two years. The testing, of course, must take place no later than the end of the second month of the first grade year.

It is no longer necessary to regard the PSTA as an experimental instrument, for evidence of its clinical applicability has been presented in this cross-validation study. The PSTA, of course, is not a perfect predictor; nor should any technique for predicting human behavior be expected to be perfect. Out of every 100 children with misarticulations who are subsequently classified on the basis of PSTA scores, it can be expected that 15 whose misarticulations will persist for two years and 18 whose errors will be overcome spontaneously may be misclassified. This margin of error, though, is quite tolerable; it is, in fact, a remarkably small error when one considers the ease, economy, reliability and convenience afforded by a standardized test which typically requires only five or six minutes to administer and score. Other techniques which have been suggested for making the same type of prediction tend to be far less economical in terms of time, often cumbersome--occasionally cumbersome even to the point of impracticality--and far from standardized in procedures for administration, scoring, or interpretation of results. Even were these deficiencies ignored, it also is true that no definitive evidence is available to support the validity of any one of the many techniques suggested in the literature. Clearly, then, the PSTA can be viewed as a useful addition to the clinician's diagnostic armamentarium.

The results also permit the following observations. Among children who present functional misarticulations at the first grade level, approximately 25 per cent may be expected to have normal articulation by the beginning of the second grade. By the time children reach the third grade, approximately 50 per cent of those who had functional misarticulations as first-graders will have normal articulation. Few, if any, of those children with normal articulation at the second grade level will have obtained PSTA scores lower than 25 as first-graders.

Before any of the possible PSTA cut-off scores are employed to select cases from a given population, however, it is strongly recommended that the clinician determine the equivalence of that population to the population which was designated as Group 1 in the present study. Other cut-off scores may function more effectively in populations which

differ in significant ways (especially, in numbers of phonemes misarticulated) from this group. If, for example, only one-half or less of the children in a group misarticulate two or fewer phonemes, then that group may resemble Group 2 of the present study more closely than it resembles Group 1. It has been shown that a very slight modification of cut-off scores might be advisable in such a situation in order to derive maximal benefit from the PSTA. It also should be noted that among groups which present, on the whole, relatively greater or smaller numbers of misarticulated phonemes, the percentage of children who will demonstrate spontaneous acquisition of normal articulation probably will vary accordingly.

In terms of future research implications, it would be of significance to investigate, among first grade children who obtain relatively high PSTA scores, the differences which may obtain between those who achieve normal articulation and those whose misarticulations persist into the third grade. Similarly, useful differentiations still might be discovered between low-scoring children who, nevertheless, attain normal articulation and those who do not. It is possible, for example, that information regarding error type and consistency--which were not directly considered in the PSTA--might significantly improve the accuracy with which children can be identified who will need professional speech help.

Another interesting problem suggested by the present results might involve follow-up studies on fourth-graders whose first grade misarticulations persisted, in some degree, into the third grade. It is entirely possible that even without therapy at least some of these children still will develop normal articulation.

This instrument could also be used to study cut-off scores which might be applied when predictive testing is desired at the second grade level; perhaps of even greater potential value would be the establishment of meaningful predictive criterion scores at the kindergarten level.

Finally, and completely aside from the problems of case identification, an instrument such as the PSTA may well have prognostic value with respect to children at varying grade levels who are enrolled in speech therapy because of functional articulation disorders. Predictions of progress in therapy could help to resolve case selection and scheduling problems, and such indices might also begin to provide additional bases for differential evaluations of therapeutic techniques.

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APPENDIX A

INSTRUCTION MANUAL AND RESPONSE RECORD SHEET FOR THE PREDICTIVE SCREENING TEST OF ARTICULATION

GENERAL INSTRUCTIONS

The Predictive Screening Test of Articulation (PSTA) is composed of 47 items which, for convenience in administration, have been grouped into nine parts composed of from 1 to 22 items each. Instructions for administering and scoring each part of the test are given below.

Response sheets are provided for recording responses to the test items, and a separate response sheet is to be used for each child tested. Before beginning to test a child, the examiner should complete the identifying information at the top of the response sheet (except for the "Total Score", which can be obtained only after the test administration has been completed).

During the administration of the PSTA the examiner should indicate, on the response sheet, the child's response to each item. This should be done by circling the 1 if the response was correct or by circling the 0 if the response was incorrect. Any item to which the child gives no response should be scored as an incorrect response.

If, for any reason, the examiner is unable to hear the child's first response to an item, the child may be asked to repeat his response. The examiner may not repeat a stimulus word or sound more than the specified number of times, however, unless it is clear that extraneous noise or some other distraction obviously kept the child from hearing the initial stimulus presentation.

After all of the 47 items have been administered and scored, the examiner must count the total number of correct responses given by the child. This may be done simply by tallying the number of 1's which have been circled on the response sheet. The number of correct responses should then be entered in the space provided for the child's "Total Score"at the top of his response sheet.

Total time for administering and scoring the Predictive Screening Test of Articulation typically will not exceed 7 or 8 minutes.

SPECIFIC INSTRUCTIONS

After a moment or two of preliminary conversation to put the child at ease, begin formal administration of the PSTA with the items in Part I. In the directions which follow, the words which the examiner is to speak have been capitalized.

Part I. The purpose of this group of items is to determine the accuracy of the child's response to auditory stimulation with words containing specified single consonant sounds.

Administration. Examiner says: "I AM GOING TO SAY SOME WORDS. I'LL SAY EACH WORD CLEARLY THREE TIMES. THEN YOU SAY IT BACK TO ME. YOU ONLY NEED TO SAY IT ONCE. LISTEN CAREFULLY TO HOW I SAY THEM." Examiner then presents Items 1 through 4, each time saying the stimulus word three times. The examiner is not to emphasize in any way the sound being tested; the words should be pronounced in a normal way. After the third presentation of a word the child is to say it.

Scoring. In brackets after each stimulus word is the phonetic symbol indicating which sound is being tested. In addition, the letter representing this sound has been underlined in the printed word. If the child articulates this sound correctly, circle 1 beside the corresponding item number on the response sheet. If the child misarticulates the indicated sound, circle the 0. Do not count the response as incorrect unless that specific sound is misarticulated, regardless of other possible errors in the child's production of the word.

Items.

1. RABBIT (r)
2. SOAP (s)
3. ZIPPER (z)
4. LEAF (l)

Part II. The purpose of this group of items is to determine the accuracy with which specified single consonants are articulated in words which the child says when imitating single presentations of these words by the examiner.

Administration. Examiner says: "NOW LET'S SEE IF YOU CAN SAY SOME MORE WORDS AFTER ME. THIS TIME I'LL SAY EACH WORD ONLY ONCE, SO LISTEN CAREFULLY. HERE'S THE FIRST WORD..." Examiner then presents items 5 through 17, saying each stimulus word clearly once. The examiner is not to emphsize the sound being tested. The child is to repeat each word after the examiner.

Scoring. Score in exactly the same manner as Part I is scored.

Items.

5. MUSIC (z)
6. VALENTINE (v)
7. TEETH (θ)
8. SMOOTH (ð)
9. ARROW (r)
10. BATHTUB (θ)
11. SHEEP (ʃ)
12. DISHES (ʃ)
13. CHAIR (tʃ)
14. MATCHES (tʃ)
15. WATCH (tʃ)
16. JAR (dʒ)
17. ENGINE (dʒ)

Part III. The purpose of this group of items is to determine the accuracy with which specified two- and three-consonant blends are articulated in words which the child says when imitating single presentations of these words by the examiner.

Administration. Part III is identical in administration to Part II; so there is no need at this point to give any new instructions to the child. The examiner is simply to continue with presentations of the stimulus words, saying each word clearly once. The child continues to repeat each word after the examiner.

Scoring. Each of the items 18 through 38 tests the child's articulation of a consonant blend. Except for this, the scoring is similar to Parts I and II. In brackets after each stimulus word are the phonetic symbols indicating the blend which is being tested. In addition, the letters

representing this blend have been underlined in the princed word. If the child articulates the entire blend correctly, circle 1 beside the corresponding item number on the response sheet. If the child misarticulates any portion of the indicated blend, circle the 0. For example, if the child says "pwesents" for "presents" the pr blend is to be counted as incorrect. Do not count the response as incorrect, however, unless some part of the specific blend is misarticulated, regardless of other possible errors in the child's production of the word.

Items.

18. PRESENTS (pr)
19. BREAD (br)
20. CRAYONS (kr)
21. GRASS (gr)
22. FROG (fr)
23. THREE (θr)
24. CLOWN (kl)
25. FLOWER (fl)
26. SMOKE (sm)
27. SNAKE (sn)
28. SPIDER (sp)
29. STAIRS (st)
30. SKY (sk)
31. SWEEPING (sw)
32. PLANT (pl)
33. SHREDDED WHEAT (ʃr)
34. TREE (tr)
35. DRESS (dr)
36. SLED (sl)
37. SPLASH (spl)
38. STRING (str)

Part IV. The purpose of this item is to determine the accuracy with which all of the sounds are articulated in a sentence which the child repeats after hearing the examiner say that sentence.

Administration. This item begins with an example for the child. Examiner says: "NOW LET'S SEE IF YOU CAN SAY A WHOLE SENTENCE AFTER ME. SAY THIS: 'THE RADIO FELL DOWN'." Do not score this response. It is used only as a model to prepare the child to say the actual test sentence. After the child responds to the example, the examiner says: "GOOD, NOW SAY THIS SENTENCE..." Then the examiner says the sentence in item 39 below.

Scoring. The child's response to this item is scored with reference both to his articulation and to his ability to reproduce the entire sentence. If the child misarticulates any sound in the sentence, count his response as incorrect and circle the 0. If he omits a word from the sentence, count the response as incorrect--even if the words which he does repeat are correctly articulated. The insertion of an additional word does not make the response incorrect if the sentence is otherwise correct. In order to score a correct response, the child must repeat every word of the sentence and must articulate every sound correctly.

Item. 39. THIS RADIO LOOKS LIKE IT'S BUSTED.

Part V. The purpose of these items is to determine the child's ability to produce the (s) and (θ) in isolation following auditory stimulation by the examiner.

Administration. Examiner says: "NOW I'D LIKE TO HAVE YOU SAY THIS SOUND AFTER ME..." The examiner then produces one strong and clear (s) sound, prolonging the sound for approximately three seconds. The child is then to repeat the sound. The same procedure is followed for (θ).

Scoring. Circle the 1 for a correct response if the sound is produced correctly by the child. Ignore the duration of his production. If complete or partial failure occurs or if child refuses to try, count the response as incorrect.

Items. 40. Production of (s) in isolation, sustained for three seconds.

41. Production of (θ) in isolation, sustained for three seconds.

Part VI. The purpose of these items is to determine the child's ability to articulate the (s), (z), (p), (t) and (k) sounds correctly in specified syllables.

Administration. Examiner says: "NOW LET'S SAY SOME OTHER SOUNDS. I WANT YOU TO SAY JUST WHAT I SAY..." Examiner then presents items 42, 43 and 44, pausing to allow the child to respond after each presentation.

Scoring. Score the response to 42 and 43 as correct if the child repeats any one of the three nonsense syllables correctly, even though others may be misarticulated. Thus, "theeseethee" for "seeseesee" would be counted as a correct response. Score the child's response as incorrect only if all three syllables are misarticulated. On item 44, however, all three syllables must be correctly articulated to be scored as a correct response.

Items. 42. SEESEESEE (sisisi)

43. ZOOZOOZOO (zuzuzu)

44. PUHTUHKUH (pʌtʌkʌ) - All must be correct

Part VII. The purpose of this item is to determine the child's ability to move the tongue independently of the jaw and lips in producing the syllable "la".

Administration. Examiner says: "NOW PUT YOUR THUMB IN YOUR MOUTH LIKE THIS, AND SAY (examiner demonstrates, biting on thumb with upper and lower central incisors--thumbnail down) 'LA-LA-LA'."

Scoring. Score the response as incorrect if no "la" is heard. Also score the response as incorrect if the lips purse around the thumb, even if "la" is heard. Score the response as correct if "la" is produced correctly at least once of the three times and if this "la" is produced without a pursing of the lips.

Item. 45. (lalala), produced as indicated above.

Part VIII. The purpose of this item is to determine the child's ability to discriminate between a correct and an incorrect production of (ʃ) and to identify the incorrect production.

Administration. Examiner begins by saying: "I WANT TO FIND OUT IF YOU KNOW WHEN I SAY A WORD RIGHT OR KNOW WHEN I SAY IT WRONG. YOU KNOW WHAT THIS IS... (Examiner points to own nose.). NOW, THIS HAND (Examiner indicates either of his own hands.) SAYS THAT IT'S MY NOTH (noʃ), AND THIS HAND (indicating other hand) SAYS THAT IT'S MY NOSE. WHICH

HAND SAID IT WRONG?" (Example may be repeated using words "mouth" and "mouse", or other pairs, until child understands that he is to point to the incorrect hand.) "HERE'S ANOTHER CHANCE TO CATCH ME. Is THIS (examiner indicates right hand) MY FINGUH (fɪŋgə), OR IS IT (examiner indicates left hand) MY FINGER? WHICH ONE DID I SAY WRONG? POINT TO IT."

Scoring. Score the response as correct if the child correctly identifies the examiner's incorrect production of the test word.

Item. 46. (fɪŋgə..fɪŋgɚ) presented as indicated above

Part IX. The purpose of this item is to determine the child's ability to replicate a hand-clapping rhythm presented by the examiner.

Administration. Examiner says: "NOW LET'S SEE IF YOU CAN CLAP YOUR HANDS JUST LIKE I DO." Examiner then demonstrates by clapping this rhythm: clap....clap....clap..clap..clap. The first, second, and third claps are separated in time by intervals of approximately one second. The intervals between the third and fourth and the fourth and fifth claps are about one-half as long.

Scoring. Score the child's response as correct if the rhythm and number of claps are accurate. Score the response as incorrect if rhythm is not accurate or if there is either an extra or insufficient number of claps.

Item. 47. Clapping rhythm, presented as indicated above.

PREDICTIVE SCREENING TEST OF ARTICULATION (PSTA), U. S. Office of Education Grant 3-7-068717-0198, Project No. 3-8717, C. Van Riper, Western Michigan University, 1968

RESPONSE SHEET

Child's Name _____ Birthdate _____ CHILD'S TOTAL SCORE _____

Grade _____ School _____ Examiner _____

City _____ State _____ Date _____

Record the child's response to each item of the PSTA by circling the 1 if his response is correct or by circling the 0 if his response is incorrect (or if no response is made). Compute the child's "Total Score" by counting the number of items where 1 has been circled. Enter this score in the appropriate space at the top of the response sheet.

Item	Response		Item	Response		Item	Response	
Part I			**Part III**					
1. RABBIT	1	0	18. PRESENTS	1	0	37. SPLASH	1	0
2. SOAP	1	0	19. BREAD	1	0	38. STRING	1	0
3. LEAF	1	0	20. CRAYONS	1	0	**Part IV**		
4. ZIPPER	1	0	21. GRASS	1	0	39. Sentence	1	0
Part II			22. FROG	1	0	**Part V**		
5. MUSIC	1	0	23. THREE	1	0	40. (s)	1	0
6. VALENTINE	1	0	24. CLOWN	1	0	41. (θ)	1	0
7. TEETH	1	0	25. FLOWER	1	0	**Part VI**		
8. SMOOTH	1	0	26. SMOKE	1	0	42. SEESEESEE	1	0
9. ARROW	1	0	27. SNAKE	1	0	43. ZOOZOOZOO	1	0
10. BATHTUB	1	0	28. SPIDER	1	0	44. PUHUHXUH	1	0
11. SHEEP	1	0	29. STAIRS	1	0	**Part VII**		
12. DISHES	1	0	30. SKY	1	0	45. LA-LA-LA	1	0
13. CHAIR	1	0	31. SWEEPING	1	0	**Part VIII**		
14. MATCHES	1	0	32. PLANT	1	0	46. (ʃ) Recognition	1	0
15. WATCH	1	0	33. SHREDDED WHEAT	1	0	**Part IX**		
16. JAR	1	0	34. TREE	1	0	47. Clapping rhythm	1	0
17. ENGINE	1	0	35. DRESS	1	0			
			36. SLED	1	0			

APPENDIX B

FREQUENCY (f) AND CUMULATIVE FREQUENCY (cf) DISTRIBUTIONS OF SCORES OBTAINED ON THE SECOND EXPERIMENTAL FORM OF THE PSTA BY GROUP 1 AND GROUP 2 CHILDREN WHO CONTINUED TO HAVE DEFECTIVE ARTICULATION AT THE SECOND GRADE LEVEL AND BY THOSE WHO HAD NO MISARTICULATIONS AT THE SECOND GRADE LEVEL.

	Group 1				Group 2			
	Still Defective (n = 119)		Normal (n = 39)		Still Defective (n = 74)		Normal (n = 21)	
PSTA Score	f	cf	f	cf	f	cf	f	cf
47	0	119	0	39	1	74	1	21
46	1	119	0	39	0	74	0	20
45	0	118	2	39	0	74	1	20
44	2	118	5	37	0	74	2	19
43	3	116	4	32	1	73	0	17
42	4	113	3	28	2	72	0	17
41	3	109	1	25	2	70	4	17
40	6	106	2	24	3	68	0	13
39	7	100	2	22	1	65	2	13
38	5	93	3	20	2	64	0	11
37	3	88	1	17	1	62	0	11
36	5	85	2	16	2	61	1	11
35	5	80	1	14	5	59	1	10
34	3	75	1	13	2	54	0	9
33	9	72	1	12	4	52	1	9
32	4	63	2	11	3	48	0	8
31	7	59	3	9	4	45	2	8
30	11	52	1	6	3	41	0	6
29	4	41	1	5	6	38	2	6
28	5	37	0	4	3	32	1	4
27	4	32	3	4	4	29	1	3
26	2	28	0	1	2	25	1	2
25	5	26	1	1	2	23	1	1
24	3	21	0	0	2	21	0	0
23	4	18			1	19		
22	1	14			2	18		
21	1	13			4	16		
20	1	12			2	12		
19	0	11			2	10		
18	3	11			2	8		
17	2	8			1	6		
16	2	6			1	5		
15	0	4			1	4		
14	1	4			0	3		
13	3	3			0	3		
10	0	0			2	3		
4					1	1		
3					0	0		

APPENDIX C

RELATIVE FREQUENCIES OF PASSING RESPONSES FOR EACH ITEM OF THE PSTA AMONG SUBJECTS WITH NORMAL ARTICULATION AND SUBJECTS WITH MISARTICULATIONS AT THE THIRD GRADE IN THE ORIGINAL PROJECT GROUP AND THE TWO CROSS-VALIDATION GROUPS.

Item Number	Original Subjects: Normal Group (n = 63)	Original Subjects: Still Defective Group (n = 71)	Cross-Validation Subjects: Group 1: Normal Group (n = 70)	Cross-Validation Subjects: Group 1: Still Defective Group (n = 74)	Cross-Validation Subjects: Group 2: Normal Group (n = 29)	Cross-Validation Subjects: Group 2: Still Defective Group (n = 52)
1	.84	.62	.77	.57	.93	.77
2	.75	.45	.67	.42	.76	.50
3	.98	.80	.96	.86	.93	.71
4	.73	.44	.60	.47	.76	.38
5	.76	.39	.64	.53	.59	.50
6	.87	.72	.83	.78	.93	.62
7	.63	.38	.67	.54	.62	.50
8	.52	.34	.61	.51	.55	.35
9	.86	.70	.71	.70	.97	.71
10	.67	.49	.71	.51	.55	.44
11	.90	.76	.90	.73	.86	.71
12	.86	.68	.94	.73	.83	.67
13	.92	.73	.96	.84	.83	.81
14	.92	.76	.90	.88	.86	.77
15	.95	.79	.97	.86	.93	.77
16	.98	.84	1.00	.93	.86	.85
17	.95	.79	.99	.92	.93	.81
18	.92	.63	.79	.69	.90	.73
19	.86	.65	.79	.61	1.00	.75
20	.92	.63	.81	.68	.97	.87
21	.89	.65	.83	.68	1.00	.77
22	.92	.55	.69	.61	.97	.71
23	.73	.52	.64	.55	.76	.52
24	.95	.66	.91	.86	.90	.77
25	.89	.65	.90	.81	.90	.75
26	.63	.30	.66	.54	.52	.44
27	.67	.31	.71	.53	.52	.44
28	.65	.30	.70	.54	.55	.44
29	.65	.25	.70	.55	.59	.50
30	.65	.28	.67	.54	.59	.46
31	.62	.32	.63	.53	.45	.38
32	.97	.70	.93	.89	.90	.77
33	.71	.35	.41	.34	.34	.27
34	.97	.73	.80	.76	.93	.77
35	.95	.73	.86	.72	1.00	.81
36	.62	.30	.66	.53	.55	.38
37	.57	.21	.54	.45	.45	.38
38	.59	.18	.64	.43	.52	.38
39	.41	.10	.31	.12	.28	.17
40	.78	.49	.80	.50	.76	.54
41	.87	.73	.76	.68	.76	.67
42	.73	.49	.73	.50	.79	.58
43	.76	.42	.77	.49	.72	.48
44	.67	.49	.60	.49	.55	.40
45	.98	.84	.93	.89	.83	.73
46	.95	.83	.89	.89	.93	.81
47	.89	.66	.77	.65	.52	.56

APPENDIX D

FREQUENCY (f), CUMULATIVE FREQUENCY (cf) AND CUMULATIVE RELATIVE FREQUENCY (crf) DISTRIBUTIONS OF SCORES OBTAINED ON THE PSTA BY "NORMATIVE" GROUP OF KINDERGARTEN CHILDREN.

Score	Kindergarten Girls (n = 531) f	cf	crf	Kindergarten Boys (n = 591) f	cf	crf
47	65	531	1.00	43	591	1.00
46	67	466	.87	70	548	.93
45	52	399	.75	48	478	.81
44	44	347	.65	41	430	.73
43	39	303	.57	37	389	.67
42	38	264	.49	33	352	.60
41	23	226	.42	30	319	.54
40	16	203	.38	26	289	.49
39	26	187	.35	26	263	.45
38	11	161	.30	19	237	.40
37	13	150	.28	16	218	.37
36	13	137	.25	13	202	.34
35	6	124	.23	12	189	.32
34	6	118	.22	12	177	.30
33	8	112	.21	11	165	.28
32	10	104	.19	15	154	.26
31	8	94	.17	12	139	.24
30	10	86	.16	13	127	.21
29	10	76	.14	9	114	.19
28	10	66	.12	9	105	.18
27	8	60	.11	9	96	.16
26	5	52	.09	12	87	.15
25	7	47	.08	11	75	.13
24	10	40	.07	4	64	.11
23	0	34	.06	11	60	.10
22	3	34	.06	7	49	.08
21	3	31	.05	2	42	.07
20	1	28	.05	4	40	.07
19	3	27	.05	2	36	.06
18	2	24	.04	5	34	.06
17	4	22	.04	5	29	.05
16	3	18	.03	3	24	.04
15	4	15	.02	2	21	.04
14	1	11	.02	3	19	.03
13	3	10	.01	2	16	.03
12	2	7	.01	3	14	.02
11	0	5	.01	0	11	.01
10	0	5	.01	0	11	.01
9	1	5	.01	2	11	.01
8	0	4	.01	2	9	.01
7	1	4	.01	3	7	.01
6	3	3	.01	1	4	.01
5	0	0	.00	3	3	.01
4				0	0	.00

APPENDIX E

FREQUENCY (f), CUMULATIVE FREQUENCY (cf) AND CUMULATIVE RELATIVE FREQUENCY (crf) DISTRIBUTIONS OF SCORES OBTAINED ON THE PSTA BY "NORMATIVE" GROUP OF FIRST GRADE CHILDREN.

Score	First Grade Girls (n = 487) f	cf	crf	First Grade Boys (n = 484) f	cf	crf
47	90	487	1.00	80	484	1.00
46	95	397	.82	80	404	.83
45	70	302	.62	68	324	.67
44	29	232	.48	40	256	.53
43	30	203	.42	27	216	.45
42	17	173	.36	24	189	.39
41	23	156	.32	17	165	.34
40	22	133	.27	10	148	.31
39	11	111	.23	15	138	.29
38	11	100	.21	11	123	.25
37	8	89	.18	7	112	.23
36	6	81	.17	10	105	.22
35	6	75	.15	4	95	.20
34	6	69	.14	8	91	.19
33	7	63	.13	6	83	.17
32	8	56	.11	6	77	.16
31	9	48	.10	12	71	.15
30	8	39	.08	8	59	.12
29	5	31	.06	6	51	.11
28	4	26	.05	4	45	.09
27	5	22	.05	5	41	.08
26	3	17	.03	2	36	.07
25	2	14	.02	7	34	.07
24	2	12	.02	5	27	.06
23	3	10	.02	3	22	.05
22	1	7	.01	4	19	.04
21	0	6	.01	4	15	.03
20	1	6	.01	1	13	.03
19	2	5	.01	0	0	.02
18	1	3	.01	2	12	.02
17	0	0	.004	2	10	.02
16	0	0	.004	0	0	.02
15	0	0	.004	1	8	.02
14	0	0	.004	0	0	.01
13	0	0	.004	1	1	.01
12	1	1	.004	0	0	.01
11	0	0	.002	3	3	.01
10	0	0	.002	0	0	.01
9	0	0	.002	0	0	.01
8	0	0	.002	0	0	.01
7	0	0	.002	1	3	.01
6	1	1	.002	0	0	.004
5	0	0	.000	1	2	.004
4				0	0	.002
3				1	1	.002
2				0	0	.000

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TITLE

Cross-Validation of a Predictive Screening Test for Children with Articulatory Speech Defects: Final Report

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Predictive Articulation Testing

ABSTRACT

Many speech clinicians and researchers have observed that immature articulation skills among first grade elementary school children often improve spontaneously by the third grade level. Among those children whose articulation skills do not follow this developmental process, however, are some whose articulatory errors may become habituated during this same time period unless they are able to receive early therapy from the speech clinician. In the present study it was demonstrated that a useful differentiation can be made--between first-graders who, without speech therapy, will acquire normal articulation by the third grade and those who will not--on the basis of scores obtained on a 47-item empirically derived Predictive Screening Test of Articulation. The PSTA, when used appropriately, appears to be a potentially valuable supplement to the diagnostic techniques and instruments currently available to the speech clinician.