A COMPARISON OF TWO ARTICULATION TREATMENTS: ACQUISITION AND ACQUISITION-AUTOMATIZATION

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ABSTRACT

Thirty-four children who misarticulated either the /s/ or /r/ sound were randomly divided into two groups of 17 children each. One group received sound acquisition training administered by an experimenter; children in the other group received, in addition to the acquisition training provided by an experimenter, an automatization treatment administered by their parents. Two-factor ANOVAs showed no significant differences in articulation between the two treatment groups for sound production tasks or talking tasks, but did show a significant improvement in articulation over time for the two groups combined. Essentially the same results were obtained when the two groups were broken into /s/ and /r/ subgroups and the data were reanalyzed. However, inspection of data plots for each subject suggested that subjects taught /r/ by the combined treatment tended to exceed the achievement of children taught /r/ by the acquisition method only.

Articulation remediation may be conceptualized in perceptual-motor learning terms wherein the clinician structures therapy to include perceptual, decision, and performance activities (Shelton and McReynolds, 1979). The distinction between acquisition and automatization of articulatory skills is an important part of the performance portion of this model. Often automatization training is delayed until the client reaches criterion on an acquisition measure such as ability to articulate a target sound correctly in a set of training words and perhaps until generalization to correct usage of the sound in untaught items has been observed. However, in a study of self-monitoring in articulation correction, Diedrich (undated) made an observation which suggests it may be a mistake to delay automatization activities until a high level of performance has been achieved on either training or generalization items. In measuring subjects' articulation of target sounds in sound production tasks and in three minute samples of conversational speech, Diedrich found that sometimes the two measures began to show improvement simultaneously. Perhaps a treatment combination that introduces acquisition and automatization procedures simultaneously may be more efficient than use of the same procedures in the more traditional sequential presentation.

This study was intended to compare two treatments for effectiveness. One treatment involved articulation response acquisition and the other a combination of response acquisition and response automatization activities.

Procedure

Thirty-four children served as subjects. They ranged in age from 5-0 to 6-0 years, and scored five or fewer correct productions on a 30-item /s/ sound production task or 7 or fewer correct productions on a 45-item /r/ sound production task (Arndt et al., 1977).

Subjects were assigned randomly to one of the two treatment groups, 17 children in each group. In each group, nine children were taught /s/ and eight children were taught /r/. all children passed a hearing screening test at 500 - 4000 Hz at 20 dB (ANSI, 1969). Children in Group I presented a mean standard score of 40 with a standard deviation of 7 on the Auditory Association Subtest of the Illinois Test of Psycholinguistic Abilities. The mean standard score for Group II was 41 with a standard deviation of 7. Peabody Picture Vocabulary Test means and standard deviations were 105 and 11 for Group I and 109 and 11 for Group II. Table 1 reports McDonald Screening Deep Test scores for children in each group.

Table 1. Articulation data for Group I, acquisition only treatment, and Group II, acquisition and automatization treatments. Sound production task and talking task scores are percentage of correct responses; McDonald test scores are number of correct responses. Baseline data were computed from responses averaged across three administrations.

	Baseline	Lesson 5	Lesson 10	Lesson 16	1-mo Post	3-mo Post
Sound Production Task						
Group I						
Mean	1.2	16.6	41.2	55.6	48.3	46.2
SD	2.4	21.8	37.2	37.6	42.0	39.7
Group II						
Mean	2.6	32.3	50.1	70.4	74.2	76.7
SD	5.3	36.0	37.9	31.8	26.2	21.1
Talking Task						
Group I						
Mean	0.8	—	—	33.9	30.6	32.5
SD	1.9	—	—	33.0	38.4	39.7
Group II						
Mean	1.7	—	—	41.1	38.2	42.1
SD	4.3	—	—	37.2	37.9	37.0
McDonald Deep Screening Test						
Group I						
Mean	63.4	—	—	69.7	70.4	72.4
SD	15.3	—	—	13.9	14.3	17.3
Group II						
Mean	65.1	—	—	70.2	75.1	77.8
SD	13.7	—	—	20.4	13.1	11.2

Treatment

Group I children received only a response acquisition treatment which was intended to establish correct use of the target sound in words. Word drill training was initiated as soon as the child demonstrated he or she was able to produce the target sound correctly in isolation 8 out of 10 times twice in succession. Imitation, placement techniques, and provision of information about performance were used as needed to teach production of the isolated sound. A set of 10 words was then presented under three of the stimulus conditions described by McLean (1970): (a) auditory-visual — the child was shown a picture of an object and told its name; (b) picture — the picture alone served as the stimulus, and (c) intraverbal — the child used the desired word to complete a statement presented by the examiner; for example, I eat with a knife, fork, and ______ Again, imitation, placement, and feedback of information about performance were used to facilitate correct responses if those responses were not otherwise forthcoming. Advancement from one stimulus condition to the next was dependent upon the child making 8 out of 10 responses correct twice in succession. Upon achievement of criteria for the first set of training words, the child progressed to a second set and then to a third set and then a fourth. Five words in each list started with the target sound, and five ended with that sound. Children who completed all four sets of words then practiced using the target sound in conversation. If the sound was misarticulated during talking, the child was asked to repeat the word, saying the sound correctly. This training sequence is summarized in Table 2.

Table 2

Outline of training given to members of each group. Criteria for advancement from one step or sub-step to the next are described in the text.

Step 1.	Isolation
Step 2.	First set of ten words
	Auditory-visual stimuli
	Picture stimuli
	Intraverbal stimuli
Step 3.	Second set of ten words*
Step 4.	Third set of ten words
Step 5.	Fourth set of ten words
Step 6.	Conversation

* Within Steps 3, 4, and 5 the items were first practiced under auditory-visual stimuli, then picture stimuli, and then intraverbal stimuli as for Step 2.

In addition to the experimenter administered acquisition treatment just described, Group II children received a response automatization treatment which involved parent monitoring of the child's conversational speech. The automatization treatment was conducted by one of the child's parents, and required the parent to listen to the child's conversational speech and to keep a written record of correct and incorrect productions. That record was collected every two weeks. The parents were to listen to a specified number of target-sound productions each day five days a week. They were to reward correct productions and to have the child repeat correctly a word in which the target sound was misarticulated. Ten productions were to be evaluated by the parent each day. This was systematically increased to 30 productions each day, the increases being determined by the child's performance during the previous lesson (see Appendix). This treatment, which was used in two previous studies (Shelton, Johnson, and Arndt, 1972; Shelton, Johnson, Willis, and Arndt, 1975), was continued until termination of the 8-week experimenter administered acquisition treatment.

All children in each group received 16 lessons of approximately 15 minutes each. Lessons were given twice a week for eight weeks. Two speech pathologists delivered the training; however, each child was taught by only one clinician. One clinician administered the training to 7 children in Group I and 5 children in Group II. The other clinician administered the training to 10 children in Group I and 12 children in Group II. The clinician recorded response correctness for each trial as training progressed and praised correct responses verbally. Initially each correct response was praised; however, as performance improved the ratio was decreased so that two or more correct responses preceded praise. At the end of each lesson the child chose a sticker and put it on the lesson record paper. While all children received the same number of clinician administered lessons, some progressed further through the training steps listed in Table 2 than did others. Table 3 describes how far members of the /s/ and /r/ subsets of each group progressed through the training sequence.

Table 3

Subjects' progress through the training steps which included four word lists and conversation.

	Highest Step Entered	Number of Subjects	Number of Lessons at the Conversation Level*
Group I /s/	List 3	1	
	List 4	1	
	Conversation	7	3, 4, 5, 7, 8, 8, 9
/r/	List 1	1	
	List 4	1	
	Conversation	6	1, 1, 2, 3, 5, 8
Group II /s/	List 1	1	
	List 2	1	
	Conversation	7	7, 7, 7, 9, 10, 11, 12
/r/	List 2	2	
	List 3	1	
	List 4	1	
	Conversation	4	2, 5, 6, 7

*Each number reports how many lessons one subject spent in conversation.

For Group II, the acquisition treatment was initiated first. As soon as a child correctly articulated the target sound in five of the first set of ten training words under the picture stimulus condition, the child's parent was oriented to the automatization treatment and then the two treatments were administered simultaneously. The number of weeks during which the parents administered response automatization treatment varied because the subjects differed in number of acquisition treatments used to reach the criterion for initiation of automatization work. Thus, the duration of the parent administered treatment ranged from two to eight weeks with an average of five weeks.

A parent of each subject was taught to focus his or her attention on the child's target sound and to discriminate between correctly and incorrectly articulated sounds. A discrimination tape was played which required the parent to identify the target sound, select the word which contained the target sound, count the number of times the target sound appeared in a word, determine whether the target sound appeared at the beginning, middle, or end of a word, and determine if the target sound was correctly or incorrectly articulated. The parent also listened to and evaluated a tape recording of a child's speech. First, he or she scored as correct or incorrect the target sound in each word of a 30-item sound production task. Second, the parent scored the target sound in 30 words of the child's conversational speech using a typed script with the target sound underlined. Third, he or she listened to a portion of the same conversational sample, but this time no script was provided and the parent was required to identify those words containing the target sound, write them down, and score the target sound as correctly or incorrectly articulated. A video tape showing a parent engaged in the speech monitoring procedure was shown to the parent, the procedure was explained, and the parent was given a written instruction sheet and record forms. The parent then observed his or her own child demonstrate correct production of the target sound, and the investigator and child briefly demonstrated the procedure to the parent. Parent instructions are included in the Appendix.

Dependent Variables

Sound production tasks printed by Arndt **et al.** (1977) were used to measure generalization of correct production of the target sound to untaught word items; they were administered three times prior to the first lesson and again following lessons 5, 10, and 16, and one and three months after lesson 16. The /s/ task used 30 items, and the /r/ task 45 items — fifteen for each of the allophones /r/, /ɝ/, and /ɚ/. Because the tasks differ in number of items, sound production tasks are reported in terms of percentage of items produced correctly.

Thirty-item talking tasks (Wright, Shelton, and Arndt, 1969) were used to measure automatization of the target sound in conversation; they were administered prior to the first lesson, following lesson 16, and one and three months after lesson 16. The McDonald Screening Deep Test of Articulation (1968) was also used; it was administered according to the same schedule as the talking task.

All articulation responses were scored live by two independent observers. Means and standard deviations for percentage of agreement between observers were as follows: /s/ sound production task 95 and 10, /r/ 96 and 7; /s/ talking task 93 and 11, /r/ 93 and 8; McDonald Screening Deep Test 93 and 5.

Results

Means and standard deviations for the articulation measures are shown in Table 1. A two factor analysis of variance was computed to determine if articulation scores differed in probes administered at different times during the course of the study (pre-treatment, treatment, and post-treatment) and whether the two treatment groups differed in their responses to the probes. The analysis showed that sound production task performance for the two groups of subjects combined improved significantly over time ($F = 44.15$; df $= 5{,}160$; $p < .01$). A Newman-Keuls test showed that means for each of the six sound production task administrations were significantly different from all the others with the exceptions of lesson 16, 1-month post treatment, and 3-month post treatment which were not significantly different from each other. Data from each subject's three pre-treatment probes were averaged together for a single entry into the analysis of variance computation. Use of the estimated omega squared statistic (ω^2), which is an index to the amount of dependent variable variance accounted for by the independent variable, indicated that about 34% of the sound production task variance was accounted for by improvement in performance overtime. Differences between the two groups in sound production task performance (Table 1) favored Group II which received both treatments ($F = 3.81$; df $= 1{,}32$; $p < .06$); however, use of ω^2 indicated that only about 3%

of the variance in sound production task performance was accounted for by the difference between groups.

Talking task improvement was not significantly different for the two treatment groups ($F = 0.59$; $df = 1,32$; $p = .45$), but a significant improvement for the two groups of subjects combined did occur over time ($F = 18.65$; $df = 3,96$; $p < .01$). Similarly, McDonald Screening Deep Test improvement was not significantly different for the two treatment groups ($F = .93$; $df = 1,32$; $p = .34$), but a significant improvement for the two groups of subjects combined did occur over time ($F = 4.64$; $df = 3,96$; $p < .01$).

Table 4

Sound production task and talking task data for /s/ and /r/ subgroups within the two treatment groups. The data are reported as percentages of correct responses.

	Baseline	Lesson 5	Lesson 10	Lesson 16	1-mo Post	3-mo Post
Sound Production Task						
Group I /s/						
Mean	1.9	20.3	51.8	73.4	59.1	55.8
SD	3.2	25.2	29.4	27.5	37.1	34.1
Group I /r/						
Mean	0.6	12.8	23.6	32.8	31.0	40.4
SD	1.4	20.0	36.1	35.7	42.5	49.1
Group II /s/						
Mean	3.3	37.9	65.0	84.5	84.1	75.5
SD	7.1	41.8	36.3	29.7	20.7	25.2
Group II /r/						
Mean	2.4	20.8	29.0	52.5	61.0	78.4
SD	3.5	26.6	10.3	26.7	27.1	19.5
Talking Task						
Group I /s/						
Mean	0.8	—	—	45.0	35.8	39.1
SD	1.4	—	—	30.0	34.0	38.1
Group I /r/						
Mean	0.9	—	—	17.9	25.4	25.9
SD	2.5	—	—	28.5	44.0	42.9
Group II /s/						
Mean	2.5	—	—	55.9	48.3	37.1
SD	6.0	—	—	34.1	34.5	31.3
Group II /r/						
Mean	1.8	—	—	21.8	32.5	57.1
SD	3.2	—	—	33.8	41.9	40.0

Groups I and II each had a subgroup of subjects who were taught /s/ and another taught /r/. Table 4 reports data for those subgroups on the same observation schedule used in Table 1. A factorial analysis of variance for the sound production task data showed that performance for the four groups combined improved over time ($F = 43.77$; $df = 5,140$; $p < .01$; estimated $\omega^2 = 33\%$). Differences among the four treatment subgroups in sound production tasks were statistically significant ($F = 3.38$; $df = 3,28$; $p = .03$; estimated $\omega^2 = 7\%$). Because a significant interaction was obtained between treatment subgroup and performance over time ($F = 2.11$; $df = 15,140$; $p = .01$), one-way analyses of variance were computed for each of the six probe administrations. Significant differences among the treatment groups were found at lesson 16 ($F = 4.64$; $df = 3,28$; $p < .01$; estimated $\omega^2 = 25\%$) and at one month post treatment ($F = 3.48$, $df = 3.28$; $p < .03$; estimated $\omega^2 = 19\%$). Use of the Tukey procedure showed that at both lesson 16 and one month post treatment the /s/ subjects in Group II scored significantly higher than the /r/ subjects in Group I.

Analysis of talking task data showed that the four subgroups combined did improve over time ($F = 31.90$; $df = 3,84$; $p < .01$; $\omega^2 = 18\%$). However, the four subgroups did not differ in talking task performance ($F = 0.73$; $df = 3,28$; $p = 0.54$).

The records maintained by the parents of the children's performance at home showed that an average of 52% of the responses observed the first week were considered correct by the parents compared with an average of 86% in the sixth week.

Discussion

The statistical analysis showing improvement over time plus the use of pre-treatment, treatment, and post-treatment probes indicate that the treatments delivered to each group did influence articulation as measured by sound production tasks, talking tasks, and the Screening Deep Test of Articulation. However, from the statistical analyses conducted, we cannot conclude that there is any strong tendency toward advantage in use of the combined treatment that involved services provided by a speech pathologist and a parent. We expected the combined treatment to be more effective than the single treatment especially in terms of influence on talking task performance. The presence of the parent in the child's environment was expected to influence conversational articulation usage. However, only few of the differences between the groups in gains made were statistically significant, and any trend favorable to the combined group was greater for the sound production task than for the talking task.

This is not to say that the parent monitoring and reinforcement procedures used in this study are without value. In two previous studies (Shelton **et al.**, 1972; Shelton **et al.**, 1975), these parent administered procedures were effective in influencing talking task performance in the absence of other service. Sound production task performance was also influenced except where children were close to asymptote on the sound production task prior to the initiation of training.

Plots were prepared of the current data showing the sound production task and talking task scores of each subject pre-treatment and at lesson 5, lesson 10, lesson 16, and at the one and three month post-treatment periods. For each of the four subgroups (Group I /s/, Group I /r/, Group II /s/, and Group II /r/) these plots were arranged in order from the individual who made the least progress through the training steps to the individual who progressed the furthest. We also studied the data plots of the Group II subjects to compare sound production task and talking task performance of the children who received more than six weeks of parent monitoring with that of the children who received less than three weeks of monitoring. Three trends were evident from these visual inspections of the data plots. First, children taught /s/ tended to present more favorable sound production task and talking task profiles than children taught /r/. Second, Group II children taught /r/ presented more favorable profiles than did Group I /r/ children (Figures 1 and 2). Third, within the Group I /r/ subjects, progress through the treatment steps appeared to correlate with generalization reflected in sound production task and talking task scores (Figure 1). That is, children who progressed furthest through the training steps showed the most sound production task and talking task improvement. Otherwise, there was no clear trend relating either progress through the training steps or number of parent monitoring sessions to either generalization measure. The trend favoring Group II /r/ children over Group I /r/ children was based on a small sample, and the subjects' performance on the generalization measures was highly variable. Within the group I /r/ subjects, two subjects showed favorable profiles, and the others did poorly (Figure 1). Only one or two Group II /r/ subjects showed unfavorable profiles (Figure 2).

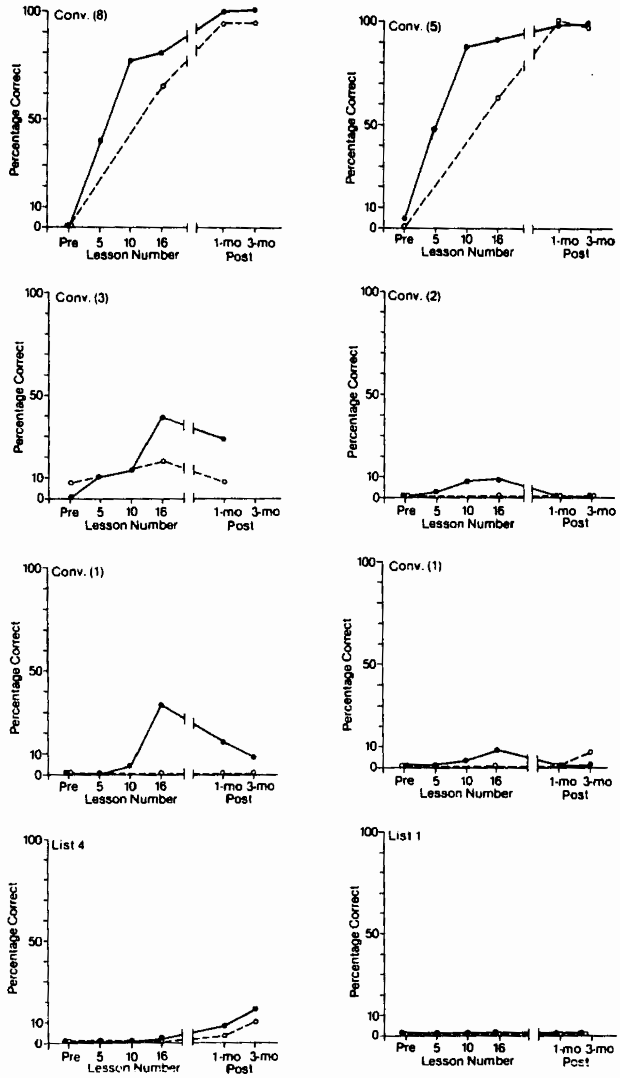

Figure 1. Sound production task and talking task data for each subject in Group I who was taught /r/. Response acquisition training was given these subjects. Information in the upper left-hand corner of each data plot indicate how far the subjects progressed through the training steps (Table 2). The three month post-treatment measures were not obtained from the third subject because a school clinician initiated additional articulation therapy prior to that time.

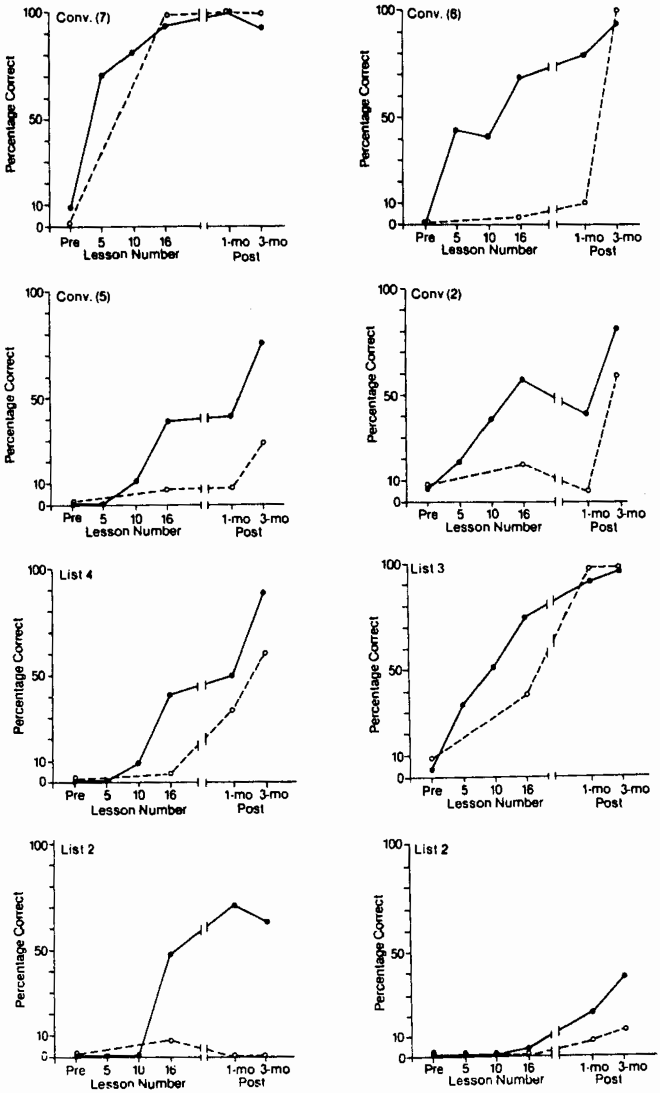

Figure 2. Sound production task and talking task data for each subject in Group II who was taught /r/. A combination of acquisition and automatization training was given to these subjects.

Speech pathologists may utilize clinician administered articulation training and parent monitoring of the child's speech either simultaneously or sequentially. As employed in this study, the combination treatment was not strongly superior to the clinician administered training by itself. Perhaps the monitoring procedure would have had greater impact had it been delivered after subjects had acquired substantial skill in the use of the target sound in speech. Nevertheless, the data reported above including inspection of plots of each subject's sound production task and talking task scores indicated that some children may respond more favorably to the early combination of the treatments than to use of the single, clinician administered treatment. Perhaps the combination treatment is advantageous under the circumstance where the child who can produce the target sound progresses slowly during the course of clinician administered training. If the combination treatment is ever advantageous, it is with a subset of persons represented by those who participated in this study. Variability in parent administration of the monitoring as well as heterogeneity among the children probably influenced the results of this study. In future work, we intend to achieve better control of parent contributions to training by specifying their tasks more explicitly and monitoring their activities more closely. Perhaps responsibility for conversational monitoring should be shared by parent and child.

We have conducted a number of investigations where children receiving articulation treatment were administered sound production tasks and talking tasks (Wright, Shelton, and Arndt, 1969; Shelton **et al.**, 1972; Shelton **et al.**, 1975; Shelton **et al.**, 1975; Ruscello and Shelton, in press). In each of these studies, performance improved in both measures but gains on the sound production tasks were greater than talking task gains except when sound production task scores were high at the beginning of the study. Talking task performance at the end of the treatment period of a given study was usually limited in that only about one-third of the items were correctly articulated. We have come to consider 33% correct in post-treatment talking tasks as a rough comparison point to be surpassed in future articulation research involving subjects who initially make five or fewer correct responses on a sound production task. This presents a challenge to identify or develop a treatment that will better improve conversational speech in a relatively short period of time. The greatest talking task gains we have achieved were in the response planning condition of the Ruscello and Shelton (1979) study. Their subjects were to plan motor articulation responses before producing them. However, subjects in that study who received articulation training involving drill and reinforcement also achieved relatively high talking task scores with training. End of treatment talking task percentage correct was 73% for the planning group compared with 57% for the practice and reinforcement group.

In future research, we anticipate placing greater emphasis on cognitive participation of children in the treatment process. This may involve response planning as used in the Ruscello and Shelton study and perhaps the use of preparatory and imperative commands in an attempt to increase the subject's attention. Presentation of preparatory and imperative commands activate the contingent negative variation which is a neuroelectrical potential that may be elicited by auditory signals and that is associated with attention (Skinner and Glattke, 1977; Shelton, 1978). We also anticipate incorporating into automatization studies a treatment procedure that places greater emphasis on the phonemic distinctiveness between the subject's error response and the standard articulation, perhaps utilizing the non-standard articulatory form in nonce items that contrast with real words (Winitz, 1975, page 73). These steps are compatible with use of a perceptual-motor information processing model of articulation remediation as discussed by Shelton and McReynolds (in press).

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APPENDIX

Parent Instructions

Listen to your child tell about a television program, a story, or an event or just listen as you talk together about anything. As the child is talking, listen for words which contain the "   " sound (as in   ). When you hear an "   " word, write down the word and score the "   " sound. If the sound was pronounced correctly, mark + and when he has completed a sentence, show him the mark and give enthusiastic praise. You may give a reward for each correct word as it is spoken (a small piece of candy or cereal for example) or you may tell him he said it correctly and later count the marks and give a reward for that number of correct pronunciations. If the sound was produced incorrectly, mark — and have him try to say the word correctly as soon as it seems appropriate to do so. Make the correction immediately unless this would discourage your child from continuing the conversation.

Scoring should be based on only whether or not the "   " sound is correct. If the "   " sound is correct, mark + even though other sounds in the word may be incorrect.

The first day listen to 10 words which have the "   " sound. Continue to listen to 10 words each day as long as 5 or fewer of the "   " sounds in those words are made correctly. When 6 or more are correct, then listen to 20 words. (Do not go back to 10 words even if the number correct drops below six). Continue to listen to 20 words as long as 10 or fewer are said correctly. When 11 or more are correct, then listen to 30 words. Continue to listen to 30 words each day for the remainder of the program.

You may use different rewards, but it is important that you choose something that is appealing to the child.

If you have any questions, please call the numbers listed below.