THE USE OF COMPETING SPEECH FOR MAKING DISMISSAL DECISIONS IN ARTICULATION THERAPY

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ABSTRACT

In order to estimate the readiness for dismissal from therapy of 76 elementary school children with /r/ or /s/ misarticulations, the Deep Test of Articulation was administered under three conditions: Condition I without auditory masking, Condition II with auditory masking, and Condition III without auditory masking three months after Condition II testing. Auditory masking took the form of a competing speech tape presented binaurally at 65 or 85 dB SPL. Each child's performance on the Deep Test with and without masking was compared to performance on the Deep Test during Condition III. Results indicated that significantly more children ($p < .05$) would have been accurately dismissed from therapy using performance on the Deep Test with masking as a criterion for dismissal than by using performance on the Deep Test without masking. The variables of sound pressure level of the masking and phoneme type did not make a significant difference in the number of children which would have been correctly dismissed from or retained in therapy.

The development of correct articulation has been discussed in terms of both acquisition and automatization (Wright, Shelton, and Arndt, 1969). Acquisition implies correct phoneme production with deliberate and conscious effort. Automatization is associated with correct articulatory production in the absence of such effort. While several attempts have been made to estimate acquisition of correct articulatory production, few investigators have dealt with the problem of estimating automatization of correct production. Recently, however, a procedure was suggested which appears to offer the clinician an efficient method for estimating whether or not a child's correct articulation has become automatized. Manning, Keappock, and Stick (1976) reasoned that where correct production of a phoneme was relatively unaffected by auditory masking, greater automatization of correct production could be assumed; where correct production of a phoneme was disrupted, automatization could not be assumed. Seventy-six elementary school children who were about to be dismissed from articulation therapy were administered the McDonald Deep Test of

Articulation under two conditions: (1) without masking and (2) with 85 dB SPL of white noise during presentation of the Deep Test. Results indicated that performance during the nonmasked administration of the Test as a criterion for dismissal from therapy would have resulted in 77% of the children being correctly dismissed from therapy. However, consideration of the children's performance during the masked administration of the Deep Test as a criterion for dismissal would have resulted in 94% of the children being correctly dismissed from therapy.

While the procedure investigated by Manning **et al.**, (1976) appears promising, the authors of this original study did not control for phoneme type and used only one level (85 dB SPL) of auditory masking (white noise). Additional information regarding the effects of such variables as sound pressure level and phoneme type, as well as the possible influence of more complex forms of auditory masking is needed. The purpose of the present investigation was to further explore the possibility of using the procedure suggested by Manning **et al**, to accurately and efficiently estimate the qutomatization of correct articulatory production in elementary school children. It was hypothesized that where childrens' correct production of a phoneme is not disrupted by auditory masking, automatization of that phoneme may be assumed and such children may be accurately dismissed from therapy; where childrens' correct production of a phoneme is disrupted by auditory masking, automatization of that phoneme may not be assumed and such children should be retained in therapy.

METHOD

Subjects

Subjects included 80 elementary school children engaged in the final stages of articulation therapy. The children were attending grades one through six. Mean age of the children was 8 years, 6 months. Each subject's misarticulations were functional in nature, as determined by their school speech clinician. All children had normal hearing as indicated by a pure tone audiometric screening test at 20 dB at octave intervals from 125 to 8000 Hz. The public school clinicians selected children who were in the final stages of therapy where automatization activities were being emphasized. Each subject had either /r/ or frontal /s/ misarticulations. There were 40 children with /r/ and 40 children with /s/ misarticulations. Children with lateral misarticulations of /s/ were not used in the study. In addition, the subjects with /r/ misarticulations did not have frontal /s/ misarticulations and the subjects with frontal /s/ misarticulations did not have /r/ misarticulations. No subject with more than two additional misarticulations participated in the investigation.

Experimental Procedures

Each subject who participated in the study was administered the McDonald Deep Test of Articulation (1964) under three experimental conditions. During Condition I all potential subjects were administered the Deep Test (Picture Form) without auditory masking. Inter-clinician reliability for scoring the Deep Test responses was obtained at the start of the investigation by administering the Test to eight children who were randomly selected (four children with /r/ misarticulations and four children with /s/ misarticulations). A comparison of the experimentor's results with two other experienced speech clinicians indicated that out of 45 possible responses, all judges were in total agreement for two of the eight subjects, within one misarticulation for five of the eight subjects, and within two misarticulations for the remaining subject. Intra-clinician reliability was obtained by

testing four subjects on two separate occasions. A comparison of the test results indicated that of the 45 possible responses, the scores were in total agreement for two of the subjects and were within one misarticulation for the other two subjects.

After calculating the percentage of correct articulations during Condition I, those subjects which scored 90% or better correct production (with one exception, all of the subjects tested) then participated in Condition II. Condition II took place during the same session as Condition I and required readministration of the Deep Test. During this Condition two different sound pressure levels of competing speech (65 dB SPL or 85 dB SPL) were presented binaurally to the children. Half of the children in the /s/ and the /r/ experimental groups were randomly selected to receive the competing speech at 65 dB SPL. There were 20 children in each of these two groups. The other half of the children (40) received the competing speech at 85 dB SPL. The mean ages of the children with /r/ misarticulations who received the competing speech at 65 and 85 dB SPL were nine years, five months and nine years, two months, respectively. The mean ages of the children with /s/ misarticulations who received the competing speech at 65 and 85 dB SPL were eight years, nine months and nine years, nine nonths, respectively.

The competing speech tape consisted of a recording a four adults (two males and two females) simultaneously reading four different phonetically balanced passages. Each speaker was seated an equal distance from the microphone (Electrovoice, model 666). Speakers practiced until each was reading at approximately the same intensity as measured by the VU meter on the tape recorder (Ampex. model PR-10). The completed tape (approximately 10 minutes in length) was then played to each child during administration of the Deep Test in Condition II. In order to prevent the children from increasing the intensity of their speech during presentation of the masking, each child was instructed to speak as loud during Condition II as they had during Condition I. Each child was given the opportunity to speak spontaneously while under the competing speech masking before taking the Deep Test during Condition II. This procedure proved to be very successful in controlling instensity change and each child was able to control his or her intensity with relative ease.

The competing speech stimuli were presented binaurally to each subject via a portable tape recorder (Sony, model TC-800B) and ear phones (Telephonic, TDH-39). The equipment was calibrated with a sound level meter (Bruel and Kjaer, model 2203) and associated artificial ear (Bruel and Kjaer, model 4152) and sound pressure microphone (Bruel and Kjaer, model 4144) according to ANSI 1969 standards.

Condition III took place during the first two weeks of school in the fall after the summer vacation. No subject received formal articulation therapy during the period between Conditions II and III. During Condition III the Deep Test was again administered without auditory masking to each subjct. Different response sheets were used for recording the results during this condition. Inter-clinician reliability of .99 was obtained for the experimentor and another experienced clinician (PR) for 34 of the children tested under Condition III.

Percentages of correct articulation were calculated for each phoneme during the three conditions. Accuracy of the dismissal decisions for traditional and experimental administrations of the Deep Test (Conditions I and II, respectively) was estimated by comparing subject performance during these Conditions with performance on the Deep Test during Condition III.

RESULTS

Because of the three to four month time lapse following Condition II, four of the children were unavailable for testing in the fall of the year. This resulted in a slight decrease in the number of children in three of the four experimental groups but did not alter the age or age range of these groups. A total of 18 and 19 children were tested under Condition III in the /r/-65 dB SPL and /r/-85 dB SPL experimental groups, respectively. A total of 20 and 19 children were tested under Condition III in the /s/-65 dB SPL and /s/-85 dB SPL experimental groups, respectively.

An overall analysis of the number and percentages of children who would have been dismissed from therapy based on Condition I performance and the accuracy of the decisions based on Condition III, is shown in Figure 1. Subject performance of 90% or better correct production during Condition I (traditional administration of the Deep Test) as a dismissal criterion would have resulted in all of the 76 subjects being dismissed from therapy. Based on the performance of these subjects during Condition III, three months later, 55 of these 76 children (72%) would have been accurately dismissed from therapy. However, 21 of the 76 children (28%) would not have been accurately dismissed since they did not reach the 90% criterion level during Condition III.

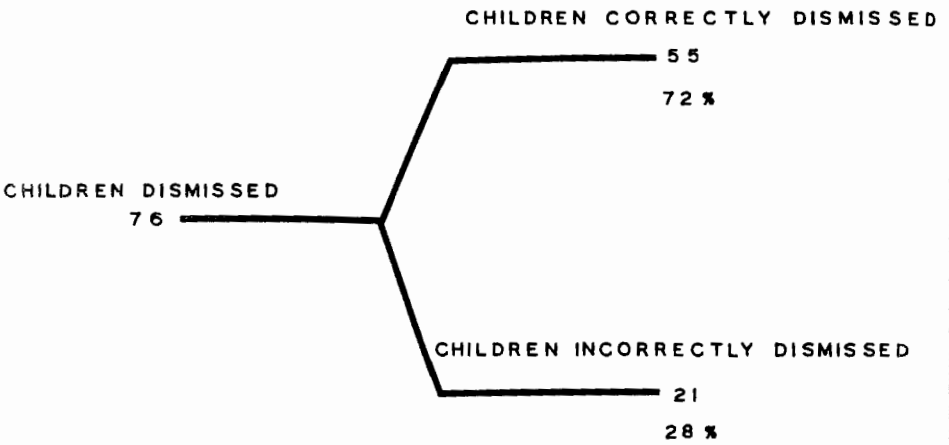

Figure 1. The number and percentage of children who would have been dismissed from therapy and the accuracy of the dismissal decision. Criterion: 90% or better correct production without auditory masking [Condition I].

The number and percentage of children who would have been dismissed from or retained in therapy based on Condition II performances and the accuracy of this decision based on Condition III performance is indicated in Figure 2. Readministration of the Deep Test under auditory masking (Condition II) resulted in 51 of the 76 children (67%) producing their particular phonemes (/r/ or /s/) correctly 90% of the time. Using the subjects' performances under auditory masking (Condition II) as a criterion for dismissal from therapy, these 51 children would have been dismissed from therapy at that time. Three

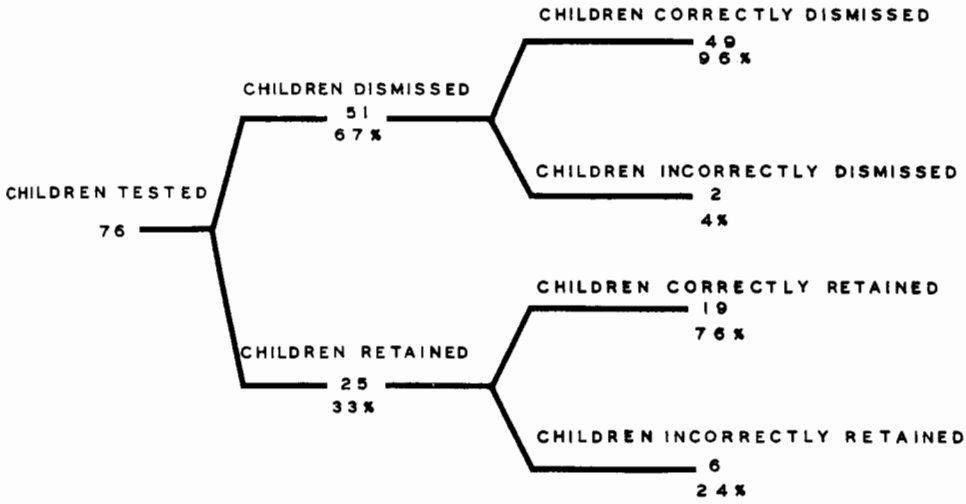

Figure 2. The number and percentage of children who would have been dismissed from or retained in therapy and the accuracy of the decision. Criterion: 90% or better correct production with auditory masking [Condition II].

months later (Condition III) 49 of these 51 children (96%) achieved at least 90% correct production on the Deep Test. Two of these 51 children (4%), while achieving 90% or better correct production during Condition II, failed to reach the 90% dismissal criterion under Condition III.

The results of a Chi Square Test for Correlated Proportions (Ferguson, 1971) contrasting subject' scores as they fell above or below the 90% level on Conditions I and III and Conditions II and III indicated that there was a significant difference ($p < .05$) between the correct dismissal predictions for Condition I and Condition II. That is, the dismissal decisions would have been significantly better using Condition II criterion than Condition I criterion.

Further analysis of the Condition II performances (Figure 2) reveals that 25 of the 76 children (33%) were unable to produce the test phoneme correctly at least 90% of the time under masking. Using this performance as a criterion for dismissal, these children would have been retained in therapy. Three months later during Condition III, 19 of these 25 children (76%) were still unable to achieve at least 90% correct production. That is, 76% of these 25 children would have been correctly retained in therapy. However, 6 of these 25 children (24%) did achieve at least 90% correct production during Condition III and would have been incorrectly retained in therapy. Thus, the use of subject performance during auditory masking as a measure for dismissal from therapy would have resulted in an accurate decision for the 49 children who were accurately dismissed as well as the 19 children who were accurately retained in therapy. This resulted in a total of 68 children, or 89% of the 76 children that participated in the study.

The results were also analyzed for each of the four experimental groups separately (/r/ at 65 dB SPL, /r/ at 85 dB SPL, /s/ at 65 dB SPL, and /s/ at 85 dB SPL). Subject performances within each of these groups were analyzed in the same manner as the overall results presented above. Analysis of the performances of the children with /r/ misarticulations indicated that in each group (those presented the masking at 65 dB SPL and those presented masking at 85 dB SPL) more children would have been accurately dismissed using the children's performance during Condition II as a criterion for dismissal than by using Condition I criterion. For those children receiving masking at 65 dB SPL, 15 of 17 children would have been accurately dismissed using Condition I criterion. Use of Condition II criterion would have resulted in 10 of 10 children being accurately dismissed. For those children receiving masking at 85 dB SPL, 11 of 19 children would have been accurately dismissed using Condition I criterion. Use of Condition II criterion would have resulted in 15 of 15 children being accurately dismissed. In addition, during Condition II, 2 of the 17 children in the /r/ at 65 dB SPL and 9 of the 19 children in the /r/ at 85 dB SPL group were unable to produce the test phoneme correctly at least 90% of the time. Using Condition II criterion, these children would have been retained in therapy. Three months later, during Condition III testing, both of the children in the 65 dB SPL group and 8 of the 9 children in the 85 dB SPL group again failed to achieve at least 90% correct production on the Deep Test. Thus retention decisions based on Condition II performance would have been very accurate for the children with /r/ misarticulations.

Analysis of the performances of the children with /s/ misarticulations also indicated that in each group (/s/ at 65 dB SPL and /s/ at 85 dB SPL) more children would have been accurately dismissed by using performance during Condition II than performance during Condition I as a criterion for dismissal from therapy. For those children receiving masking at 65 dB SPL, 15 of 21 children would have been accurately dismissed using Condition I criterion. Condition II criterion would have resulted in 11 of 11 children being accurately dismissed. For those children receiving masking at 85 dB SPL, 14 of 19 children would have been accurately dismissed during Condition I criterion while use of Condition II criterion would have resulted in 13 of 15 children being accurately dismissed. In addition, during Condition II, 10 of the 21 children in the 65 dB SPL group and 4 of 19 children in the 85 dB SPL group were unable to produce the test phoneme correctly at least 90% of the time. Using Condition II criterion, these children would have been retained in therapy. Three months later, during Condition III testing, 6 of the 10 children in the 65 dB SPL group and 3 of the 4 children in the 85 dB SPL group again failed to achieve at least 90% correct production on the Deep Test. Thus, retention decisions based on Condition II performance would also have been very accurate for the children with /s/ misarticulations.

Effect of the Sound Pressure Level of Competing Speech

Comparison of the effects of the two sound pressure levels was accomplished by contrasting the performance of the group of children who received the masking at 65 dB SPL (children with both /s/ or /r/ misarticulations) with the performance of those children who received the masking at 85 dB SPL (children with both /s/ or /r/ misarticulations). Results of a Chi Square Test (Berry, Harrington, and Pigge, 1974) indicated that there was no significant difference ($p < .05$) in the number of children who would have been correctly dismissed, incorrectly dismissed, correctly retained, or incorrectly retained in therapy for the children receiving the masking at 65 dB SPL or 85 dB SPL.

Effect of Phoneme Type

Comparison of the effects of the two phonemes on the procedure was accomplished by considering the performance of the group of children with /r/ misarticulations (children receiving masking at both 65 and 85 dB SPL) with those children having /s/ misarticulations (children receiving the masking at both 65 and 85 dB SPL). Results of a Chi Square Test (Berry, Harrington, and Pigge, 1974) indicated that there was no significant difference ($P < .05$) in the number of children who would have been correctly dismissed, incorrectly dismissed, correctly retained, or incorrectly retained in therapy for the children with /r/ or /s/ misarticulations.

DISCUSSION

The results of the present investigation support the experimental hypothesis. That is, when childrens' correct production of a phoneme were less affected by auditory masking (showing greater automatization), it appeared that these children would have been accurately dismissed from therapy based on their subsequent performance during Condition III. When childrens' correct production of phoneme were disrupted by auditory masking (showing less automatization), it appeared that these children would have been accurately retained in therapy based on their performance during Condition III. It should be realized, of course, that the present data are not interpretable as a direct index of automatization. It would appear, however, that a child's performance on the Deep Test does provide some data for inferring the presence or lack of automatization of the correct articulatory pattern. Certainly future research should consider similar procedures with other tests of articulation as well as childrens' performance during spontaneous speech under masking.

These results are similar to those of Manning, Keappock and Stick (1976). The findings of both investigations indicate that auditory masking tends to disrupt the articulatory production of children who have recently acquired the production of a phoneme. In addition, consideration of children's performance on the Deep Test during masking in both investigations provides a more accurate estimation of future articulatory performance than traditional administration of the Deep Test without auditory masking. While the relative effectiveness of white noise and competing speech for use in a procedure has not been compared, both forms of masking appear to have similar effects on misarticulating children.

The results of the present study indicated that of the 25 children that would have been retained in therapy based on Condition II criterion, 19 would have been correctly retained (Figure 2). However, 6 of these 25 children who would have been retained, should not have been, based on their performances during Condition III. As was the case in the investigation by Manning **et al**. (1976), the use of auditory masking resulted in the retention of several children who could have been dismissed from therapy. On the other hand, the more traditional dismissal criterion (presentation of the Deep Test without auditory masking) resulted in a larger percentage of children who would have been incorrectly dismissed from therapy. Given these two types of errors in predicting future

performance, it would appear more desirable to retain a child in therapy longer than might be necessary than to dismiss a child who had not yet achieved automatization of correct production.

In addition to considering the accuracy of the overall dismissal decisions for the subjects in this study, the variables of sound pressure level and phoneme type were studied. The accuracy of the dismissal decisions for the subjects tested with the Deep Test under auditory masking at 65 dB SPL were not significantly different from the performances of the subjects tested under auditory masking at 85 dB SPL. Dismissal and retention decisions were highly accurate using both levels of masking and no obvious trends were observed. The accuracy of the dismissal decisions for the subjects with /r/ misarticulations were not significantly different than the performances of the subjects with /s/ misarticulations. While both dismissal and retention decisions were very accurate for these subjects, there was a slight trend for a greater number of accurate decisions for the subjects with misarticulated /r/ phonemes than for those with misarticulated /s/ phonemes. Further, an interaction among the two variables of sound pressure level and phoneme type was noted. While the accuracy of dismissal decisions was similar for both phonemes under both levels of masking, considerably more of the subjects with /r/ misarticulations fell below the 90% correct production criterion during Condition II at 85 dB SPL than 65 dB SPL. Conversely, considerably more children with /s/ misarticulations fell below the 90% correct production criterion under masking at 65 dB SPL than at 85 dB SPL. In other words, these results suggest that if a child with a previously misarticulated /s/ phoneme was to be tested with the Deep Test with auditory masking, that child would be more likely to be dismissed if the masking was presented at 85 dB SPL (15 of 19 dismissed) than if it was presented at 65 dB SPL (11 of 21 dismissed). On the other hand, if a child with a previously misarticulated /r/ phoneme was to be tested with the Deep Test with auditory masking, that child would be more likely to be dismissed from therapy if the masking was presented at 65 dB SPL (15 of 17 dismissed), than if it was presented at 85 dB SPL (10 of 19 dismissed). If indeed these results are not due to chance or a lack of homogeneity across the four groups of children used in this study, such results suggest that standardization of masking levels may have to be undertaken.

It has been suggested that as children gain more experience at speaking and speech becomes more automatic, auditory feedback for monitoring accurate production may become relatively less important (Peterson and Shoup, 1966; Van Riper and Irwin, 1958; Fry, 1966). While this concept has not been supported in a study concerning the regulation of vocal intensity in preschool children (Siegel, Pick, Olsen and Sawin, 1976), it may be appropriate to apply this concept to the monitoring and regulation of articulation. The procedure described in the present investigation may produce a method for exploring the role of the auditory feedback channel in the articulatory production of normal and misarticulating children.

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