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ABSTRACT

To explore the efficacy of improving the dysarthria of cerebral palsy under conditions of aural stimulation, visual stimulation, and combined aural-visual stimulation, 22 subjects (aged 7.6 to 19.0 years) received intensive stimulation for word limitation for 22 consecutive school days. The 87 words of the Irwin Integrated Articulation Test were randomized and presented over a series of nine stimulations of four new words each day. The results were that combined aural-visual stimulation produced fewer errors than aural stimulation alone; errors from visual stimulation alone could not be meaningfully calculated. Words under aural-visual stimulation were rated as significantly improved from the third to the twentieth day but were still considered below average on the scale. The difficulty of sound production did not differentiate conditions analyzed according to manner of articulation or place of articulation. Voicing improved under aural-visual stimulation, but negligible correlations were obtained with sex differences, age, and IQ. Indications were that brief periods of cumulative imitation under aural-visual stimulation can bring about better motor control for articulation in cerebral palsy. (Author/JM)

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Russell J. Love
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Department of Health, Education, and Welfare

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SUMMARY

This research explored the efficacy of improving the dysarthria of cerebral palsy under three sensory modality conditions: aural stimulation, visual stimulation and combined aural-visual stimulation. Traditional approaches for ameliorating dysarthria emphasize improvement of neuromuscular control by strengthening weakened muscles and increasing the speed and precision of the speech articulators. The assumption that neuromuscular training of non-speech activities will improve speech intelligibility has been seriously questioned; it has been suggested that speech movements are probably monitored by sensory channels, particularly audition. This suggestion, plus the finding that combined aural-visual stimulation is most effective in improving sound production in nonorganic articulation disorders, prompted a test of sensory stimulation techniques on dysarthria.

Twenty-two cerebral palsied individuals, predominately spastic quadriplegics, ages 7-6 to 19-0 years, served as subjects. They met the criterion of being dysarthric, of having hearing acuity within the speech range (500-2000 Hz) of 30 dB or less (ISO), with intelligence quotients of at least 55 on the Peabody Picture Vocabulary Test.

Subjects received intensive stimulation for word imitation for twenty-two consecutive school days. The eighty-seven words of the Irwin Integrated Articulation Test for the Cerebral Palsied were randomized and presented under counterbalanced conditions over a series of nine stimulations of four new words each day.

Results indicated systematic differences between the number of sound errors under the three conditions. Combined aural-visual stimulation produced significantly fewer errors than aural stimulation alone. Errors from visual stimulation alone could not be calculated meaningfully. Experienced judges ranked the overall speech adequacy of the words produced on a 13 point scale and rated words under aural-visual stimulation as significantly improved from the third to twentieth day of stimulation, but even improved ratings were considered below average on this scale. The rank order of difficulty of sound production, analyzed according to manner of articulation, did not differentiate aural-visual and aural conditions. Analyzed according to place of articulation, the order of difficulty between the aural-visual and aural condition did not vary greatly. However, the more visible sounds tended to be produced with less error under aural-visual stimulation. Voicing improved significantly under aural-visual stimulation. No sex differences in number of articulation errors were found, and negligible correlations were obtained with age and IQ.

The most striking aspect of these findings is that brief periods of cumulative imitation, preferably under aural-visual stimulation can bring about better motor control for articulation in cerebral palsy.

It can be conjectured that controlled sensory stimulation may be more effective than neuromuscular training in modifying dysarthria. However, it should be pointed up that even after improvement the overall speech adequacy was rated below average. This indicated the need for more than a single measure for assessing dysarthria and suggests the need for further research to test and control maintenance of improvement over time by a program of operant conditioning wherein schedules of rewarding reinforcement will be applied to correct imitations produced by aural-visual stimulation.

INTRODUCTION

Cerebral palsy may be defined as a disorder of movement and posture due to a defect or lesion of the immature brain (Bax, 1964). If the disorder involves the muscles of respiration, phonation, resonation or articulation, the resulting speech or voice problem is called dysarthria. The paralysis, weakness, or incoordination of the speech musculature may be mild to severe, but the usual result is some degree of unintelligible speech. Although the child with cerebral palsy may have other problems caused by cerebral dysfunction - such as disorders of sensation, perception, concept formation and symbol formulation - which will disturb or limit his use of speech and language, dysarthria usually is the major communication problem. (Ingram, 1966, Love, 1964, Lencione, 1966).

Estimates of incidence and severity of dysarthria in the cerebral palsied population vary. Using intelligibility of speech as an indicator of incidence, most investigators (Lencione, 1966, p. 229; Wolfe, 1950) suggest that athetoids are more unintelligible than spastics. Wolfe (1950) reports that 40 per cent of the athetoid group he studied was unintelligible while 30 per cent of the spastic group could not be understood. Lencione (1966) found that 70 per cent of the spastic group had intelligible speech, whereas only 31 per cent of the athetoids were intelligible. Ingram (1966) indicates that dysarthria varies also with extent of paresis. Dysarthria is more common among diplegic children than among hemiplegic children, and it occurs more often in quadriplegia than in triplegia or paraplegia.

Various therapeutic approaches have been utilized to improve the movement patterns of the speech musculature of the dysarthric child. These range from techniques based on principles of neuromuscular re-education to techniques of direct stimulation of articulation through sensory channels. The "stimulus method" described by Travis (1931), using sensory channels to improve articulation, is the traditional approach in speech pathology for correcting the motor patterns for sound production in speech disorders of a nonorganic origin (Van Riper, 1963).

Techniques having a foundation in neuromuscular re-education have been more widely advocated for the improvement of dysarthria than have the traditional techniques of sensory stimulation. For example, Westlake and Rutherford (1961) have suggested that physiological readiness for speech can be developed through stimulating oral motor activities, before and after speech has emerged. By utilizing and improving the movement patterns in chewing, swallowing and sucking, they attempt to modify them to establish those movement patterns basic for the production of sounds. They also emphasize the utilization in speech therapy of special techniques common in physical therapy. The passive-to-resisted movement continuum is employed for developing strength, speed and skill in the speech muscles. In addition, the principles of relaxation, stabilization, special posturing, and the, use of confusion and antigravity movements are stressed in the program for the development of motor patterns for speech. When movement patterns are finally established, traditional direct sensory stimulation techniques are employed.

This intensive emphasis on the training of non-speech activities to improve speech production in the cerebral palsied has been criticized by Hixon and Hardy (1964). They provide evidence to indicate that speech defectiveness in the cerebral palsied is highly correlated with speech movements of the articulators and not strongly related to non-speech movements. They suggest that therapy for dysarthria employing speech activities may be more effective than that using non-speech activities. On theoretical grounds, they assert that movements associated with speech emission may be more actively facilitated through sense modalities which monitor the speech act than those which monitor non-speech activities. This raises the question of whether relatively short-term sensory modality stimulation of those channels which monitor speech movements can, in actuality, facilitate more effective motor patterning for speech in the dysarthric children. A related question is: what sense modality or combination of sense modalities is most effective for improving motor speech patterns?

A model of the relative effectiveness of various types of sensory modality stimulation on phoneme production in the physically normal child with an articulation disorder has been presented by Milisen and associates (Scott and Milisen, 1954, a and b). It was found that combined aural-visual stimulation was superior to aural or visual stimulation alone in facilitating correct phonemes in isolation, nonsense syllables and words respectively. However, no evidence has yet been reported to establish the effectiveness of this model of sensory stimulation when the critical variable in the speech disorder is disturbed motor coordination of the muscles of speech rather than the presumed faulty learning of phonemes as in the nonorganic articulation disorder.

METHOD

Subjects: Twenty-two cerebral palsied individuals, between the ages of 7 years, 6 months and 19 years, 0 months, enrolled in Cavert Metropolitan Public School for the Physically Handicapped in Nashville, Tennessee, served as subjects. The average age of the group was 13.14 years. To be considered as a subject, hearing acuity of at least 30 dB (ISO) in the speech range (500 to 2000 Hz) was demonstrated. A minimum intelligence quotient of 55, as defined by the Peabody Picture Vocabulary Test, was also a criterion for inclusion in the sample. The sample was composed of 14 males and 8 females. Sixteen were clinically diagnosed as spastic, two as athetoid, one as ataxic, and three as mixed. Two were hemiplegic, and the remaining twenty were quadriplegic. For the most part, subjects were medically diagnosed by J.

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Dysarthric subjects, for the purposes of the study, were defined as presenting at least 6 errors on a standard articulation test, plus a history of chewing and swallowing problems. To rule out a speech disorder on the symbolic level rather than the motor level a subject was excluded from the sample if he was unable to formulate an utterance of four words in length. No attempt was made to rank the extent of motor involvement in the respiratory, laryngeal, palatopharyngeal, lingual, masticatory, or facial muscles. The extent of motor involvement in each of these muscle groups, comprising the vocal mechanism, was judged to be highly variable for individual subjects.

Sensory Stimulation Materials: The eighty-seven words of the Irwin Integrated Articulation Test (1961) were selected as material for presentation under three conditions of sensory stimulation: aural; visual, and combined aural-visual stimulation. Articulation test words were chosen as stimuli because they insured a representative sampling of consonant and vowel sounds in the English language in a variety of positions in words. Moreover, this articulation test material had the added advantage of being pretested for appeal and usability on a population of cerebral palsied children.

Stimulus Presentation: The eighty-seven stimulus words of the articulation test were randomized to reduce the effect of increasing motor complexity involved in sound production of the words as they appear on the test. Four words were presented each day to the subjects for 21 consecutive school days. Three new words were introduced on the twenty-second day. Each word was initially presented under the three conditions in the following order: A-V, V, A. The sensory modality conditions were counterbalanced over 6 more presentations of each word to increase and equalize practice effects. This design resulted in 36 imitations per daily session. The number of elicited responses were limited to 36 per session to reduce fatigue that might counteract practice effects. Of the nine imitated responses elicited daily, only the last three, one per sensory modality condition, were used for analysis; this final series was thought to assess best the cumulative effects of short term imitation. The responses elicited on the third, ninth, fifteenth and twentieth days were selected for analysis on the assumption that they systematically sampled the responses of the 21 days.

The aural stimuli were presented in a normal conversational voice to each subject by the examiner. The following directions were given to the subjects on the first day of stimulation:

> Today I'm going to ask you to imitate some words after you have heard and seen me say them. We will see the same words over and over again. Do your best to say the words just as I say them.

Under those conditions in which the subject was asked to reproduce the stimulus word under combined aural and visual stimulation, the following directions were given:

> I want you to watch my mouth very closely and to listen very carefully. I am going to say some words, and I want to see how well you can say what I do.

The following directions were given for those conditions in which a visual stimulus alone was presented:

> Now watch my mouth very closely. I'm going to whisp r a word and I want you to say the same word out loud after me.

The words were not actually whispered but focal articulations points were formed without any aural characteristics of the word said.

In that condition where an aural stimulus alone was presented, these directions were given:

> Now listen very carefully. I'm going to hide my mouth so that you can not see. I want to know if you can say the same word after me just as I do.

The examiner's lips were hidden by holding a 3 x 5 white card in front of the mouth. The series of directions were repeated as necessary prior to word stimulation to orient the subject and maintain motivation.

Each of the thirty-six daily responses were tape recorded on an Ampex portable 601 tape recorder for further analysis.

<u>Evaluating Stimulation Effects</u>: The effect of modality stimulation was assessed in two ways. A phonemic analysis in terms of error sounds in the test words was completed. Phoneme errors in words were recorded using traditional classifications of sound inaccuracies: substitutions, omissions, and distortions. A second analysis seemed imperative for two reasons. First, as Darley (1969) points out, dysarthric speech is more than misarticulation of sounds; it is also the result of motor disturbance of any or all of the five basic processes: respiration, phonation, resonation, articulation and prosody. Second, as McDonald (1964) argues, the individual overall motor pattern produced for a word as a whole accounts for the ultimate intelligibility of the word, rather than does the ability to produce the individual motor pattern for a single sound. Therefore, it seemed reasonable to measure the effect of stimulation on the motor patterns of speech by obtaining ratings of overall adequacy of the speech in the test words in

addition to the effect of stimulation on phoneme errors. To obtain these ratings, a group of five sophisticated listeners, defined as individuals having a Master's degree in speech pathology and at least two years of experience, were asked to rank each word in terms of general adequacy of communication on a thirteen point scale, ranging from totally inadequate speech to superior communication ability. The midpoint of the scale was defined as average speech adequacy for communication purposes. An example of the rating scale is in Appendix A. General adequacy of communication was defined as the effectiveness of the cerebral palsied child's speech attempts in an every day communication situation in which the listener does not know the speaker. Recent studies (Garrott, 1967; Coffey, 1967) have indicated that this scaling is applicable to the speech of cerebral palsied children and they further demonstrated that there are no statistically significant differences between the reliability of sophisticated listeners, as herein defined, and unsophisticated listeners, defined as those who have no training or experience in speech pathology. The judges repeated their rating after one week to obtain measures of both interjudge and intrajudge reliability.

To obtain judgments of speech adequacy, the following procedures were followed: The critical responses on the four evaluation days were selected from the speech recordings of each subject and spliced together on a master tape in random order. For identification, each sample of words was preceded by an identification code number matched to an identification code number on the scoring sheet of printed responses. The word imitations were separated by 30-second intervals to allow the judges to mark their rating sheets. The prepared master tape was played for the judges in a sound treated room with the judges seated equidistant from the loudspeaker of an Ampex 350 tape recorder. A second listening session was held for each judge a week to two weeks after the first session. A set of standard directions were read to the judges before each listening session. These directions will be found in Appendix B.

RESULTS

Modality Effects: To determine whether there were systematic differences between improvement in motor patterns for phonemes under the three types of modality stimulation for speech, the number of errors in sound production for each of the three conditions were tabulated. Initial inspection of the data revealed that errors could not be meaningfully tabulated for the visual condition. When the subjects were required to imitate a word from visual cues alone the response was frequently in the category of misnaming. Therefore, the traditional categories of sound inaccuracy could not be applied to responses from visual stimulation alone. This clearly indicated that visual modality imitation was the least effective means of controlling the motor pattern for individual sound production.

Next the total number of sound errors produced in the imitations under aural stimulation alone were compared with those produced under combined aural-visual stimulation. Table 1 indicates that the mean difference is 5.50 errors between the two conditions. This difference is statistically significant at the .01 level of confidence. Inspection of articulation tests data showed that only one subject did better under aural stimulation, and two subjects showed no change under aural stimulation, and two subjects showed no change under combined aural-visual stimulation. The remaining eighteen subjects produced from one to seventeen fewer errors under combined aural-visual stimulation than aural stimulation. This clearly demonstrates that combined aural-visual stimulation more effectively controls motor patterns for sound production in imitation than does aural stimulation alone.

The second measure of the effect of stimulation, speech adequacy, also revealed improvement with stimulation over time. On third day, the five judges assigned a mean speech adequacy rating to the cerebral palsied subjects of 3.67, placing the group as a whole between the "below average" and "poor" levels on the 13 point scale. Ratings on the twentieth day revealed a mean 4.37 indicating the speech adequacy was closer to the "below average" level. In retest data after one week or more, similar relations were maintained. The average ranking on the third day under retest was 3.68 and on the twentieth day it was 4.21, suggesting that the cumulative effects of three types of modality stimulation improved the speech adequacy of the dysarthrics.

Reliability of Judgments: To obtain an index of interjudge reliability in both test and re-test situations, Ebel's (1951) interclass correlation for estimation of reliability ratings for each of the four critical days for test and re-test were completed. (Table 2). It appears the intra- and interjudge reliability was systematically high, thus giving support to the validity of these ratings.

Age: A series of variables were explored to determine their effect on the most efficient mode of sensory stimulation. The first variable considered was age; one might assume that the number of errors might decrease with age. The results of a Pearson's product moment correlation yielded a r of -.04, indicating that as age increased the number of errors did decrease. However, the correlation is a modest, non-significant one.

Intelligence: One might also assume a negative relationship between the intellectual level of the subjects and the number of errors under the aural-visual stimulation modality. When the IQ on the Peabody Picture Vocabulary Test was correlated with the number of errors, a r of +.03 resulted. This low, non-significant positive correlation suggested a negligible relationship between intelligence and articulation error. When one considers that mean IQ level of the group was 80.81, this finding might not seem unreasonable.

Table 1. Means, Standard Deviations, Mean Difference, and Results of _t_-ratio for Related Measures between Number of Sound Errors under Aural-Visual and Aural Conditions (d.f.=21)

Condition	Mean	S.D.	Mean Difference	_t_
A-V	28.09	16.76	5.50	4.96*
A	33.59	17.36		

*Significant beyond the .01 level.

Table 2. Interclass Correlations for Reliability of Judges on Test and Re-test on 4 Selected Days.

Day	Test	Re-test
3	0.73	0.75
9	0.78	0.83
15	0.80	0.82
20	0.84	0.83

Considerable evidence (Simon, 1957) suggests that when intelligence is within the normal range, correlation with the number of articulation errors is minimal.

Sex: The literature of articulation development in normal children (McCarthy, 1954) has suggested that there are differences in the rate of achievement of articulation proficiency between boys and girls; however, these systematic sex differences have not been apparent in the cerebral palsied (Lencione, 1966). The difference in number of errors between sexes under the aural-visual condition and the aural conditions were submitted to t test and the results were not significant. (Aural-visual: $t = .14$; d.f. = 20, $p < .05$; aural: $t = .14$; d.f. = 20, $p < .05$) Thus, these findings corroborated other reports of lack of sex difference in articulation proficiency in the cerebral palsied. The critical variable appears to be degree of motor involvement of the speech mechanism (Lencione, 1966).

Manner and Place of Articulation: Irwin (1963) has suggested that a fruitful way of analyzing the articulation errors of cerebral palsied children is to study the manner and place of articulation. For the purposes of this report, it was thought that applying this approach to the errors produced under the aural-visual and visual stimulation conditions might yield further information as to the specific effects of different types of stimulation. The method proposed by Irwin (1963) for analyzing and classifying the phonemes into manner and place of articulation and a mean percentage was obtained for each of the categories of phonemes in each of the three positions. Table 3 gives the orders of difficulty of the several categories of consonants according to manner of production for the aural condition. Table 4 shows similar data for manner of production for the aural-visual condition. With the exception of some minor variation, it appears the order of difficulty under the two conditions is similar. One would expect this finding, since the addition of a combined aural-visual stimulation over an aural stimulation alone should affect place of articulation more dramatically than manner of articulation. A place of articulation analysis highlights the visual aspects of the focal articulation. It should be noted that with exception of the sounds in the medial position, the order of difficulty in manner of production was similar to that of Irwin's data on a larger sample of cerebral palsied children (Irwin, 1963).

Like comparisons were also made between the aural and aural-visual conditions for the order of difficulty according to place of articulation. Table 5 displays this data for the aural condition, while Table 6 gives data for the aural-visual conditions. Inspection of this data shows no major differences between the two modes of stimulation in rank order of difficulty. However, one can isolate effects that might be the result of the added visual component in the aural-visual condition by comparing percentages. Those sounds which have the highest visual components, the labials, do show a smaller percentage of errors in all three positions in words under aural-visual

Table 3. Order of Difficulty of Consonants According to Manner of Articulation under Aural Stimulation.

Initial	Mean %	Medial	Mean %	Final	Mean %
Stop	9%	Nasal	27%	Nasal	44%
Nasal	16%	Glide	30%	Combination	49%
Glide	17%	Stop	45%	Stop	56%
Combination	50%	Fricative	60%	Fricative	64%
Fricative	62%	Semi-Vowel	63%	Semi-Vowel	70%
Semi-Vowel	70%	Combination	70%	Glide	-

Table 4. Order of Difficulty of Consonants According to Manner of Articulation under Aural-Visual Stimulation

Initial	Mean %	Medial	Mean %	Final	Mean %
Nasal	2%	Nasal	14%	Nasal	35%
Stop	8%	Glide	22%	Combination	40%
Glide	8%	Stop	27%	Stop	59%
Combination	29%	Combination	45%	Fricative	60%
Fricative	52%	Fricative	52%	Semi-Vowel	73%
Semi-Vowel	63%	Semi-Vowel	59%	Glide	-

Table 5. Order of Difficulty of Consonants According to Place of Articulation under Aural Stimulation.

Initial	Mean %	Medial	Mean %	Final	Mean %
Labial	8%	Glottal	5%	Alveolar	53%
Velar	11%	Labial	26%	Labio-Dental	56%
Glottal	14%	Lavio-Dental	38%	Velar	56%
Alveolar	38%	Velar	44%	Dental	60%
Labio-Dental	43%	Alveolar	52%	Labial	67%
Dental	62%	Palatal	74%	Glottal	-

Table 6. Order of Difficulty According to Place of Ar iculation under Aural-Visual Stimulation.

Initial	Mean %	Medial	Mean %	Final	Mean %
Labial	5%	Glottal	9%	Alveolar	48%
Glottal	9%	Labial	12%	Velar	50%
Velar	9%	Velar	20%	Labio-Dental	54%
Alveolar	29%	Labio-Dental	36%	Dental	55%
Labie-Dental	36%	Alveolar	40%	Labial	60%
Dental	49%	Dental	51%	Palatal	71%
Palatal	50%	Palatal	60%	Glottal	-

stimulation than they do under visual stimulation alone. The other two categories of sounds that have high visual components, the labio-dentals and dentals also tended, in general, to show less error under aural-visual stimulation.

Voiced-Voiceless Production: Another parameter that has interested investigators of articulation in cerebral palsy has been the problem of voicing. No consistency in the order of difficulty has been reported (Lencione, 1966). Tables 7 and 8 reveal no clear cut differences are apparent in all three positions in the present data. However, aural-visual stimulation produced less error in the sample. This is difficult to explain in terms of the added visual component, because voicing is primarily an accoustical event. It may be that improved motor patterns under aural-visual stimulation effects tend to affect articulation as whole, and that a comparison between aural-visual elements and aural elements is artificial in the voicing problem.

CONCLUSIONS AND RECOMMENDATIONS

Clearly this study demonstrates that under conditions of immediate imitation with combined aural-visual stimulation disturbed motor patterns for articulation can be brought under better control. In other words, intensive stimulation improves dysarthria despite an often severe neurological impairment. The most striking aspect of the findings is that brief periods, often less than fifteen minutes, per each school day for less than a calendar month can produce improvement in motor patterns for phonemes as well as the other aspects of speech production presumed under the rubric of overall speech adequacy. These findings, plus the clinical observation that long-term neuromuscular training of the speech mechanism does not always greatly improve the speech adequacy of the cerebral palsied, might suggest that intensive combined sensory stimulation is a panacea for dysarthric problem. However, it should be noted that the group as a whole did not improve dramatically between the third and twentieth day. Although there was a significant upward shift in speech adequacy, the mean rating was at a "below average" level. In other words, the speech attempts never reached those of excellent, good, or average normal speakers. This suggests that no one single method will reverse dysarthria, but it does indicate that intensive combined sensory stimulation merits further research as an approach for improving disturbed motor speech function.

It is not particularly surprising that the hierarchy of effectiveness of stimulation for improvement of articulation in the dysarthric child parallels that of the physically normal children with articulation disorders. It merely supports the contention of Hixon and Hardy that sensory channels are probably of prime importance in controlling motor speech processes in the physically handicapped child as well as the normal child. It suggests that speech learning does not follow

Table 7. Difficulty of Voiced and Voiceless Consonants under Aural Stimulation.

	Initial	Medial	Final
	Mean %	Mean %	Mean %
Voiced	29.54	43.23	53.27
Voiceless	29.20	41.90	57.75

Table 8. Difficulty of Voice and Voiceless Consonants under Aural-Visual Stimulation.

	Initial	Medial	Final
	Mean %	Mean %	Mean %
Voiced	23.18	30.69	52.72
Voiceless	24.10	36.70	52.75

unique principles in the cerebral palsied, and that the traditional "stimulus method" for correcting phonemes must not be under-emphasized in relation to neuromuscular training. The lack of differences in terms of the normally critical variables of intelligence, sex, and age support the findings of other investigators dealing with cerebral palsy, who suggest the degree of motor involvement in the speech articulators determines the number of sound errors.

It also becomes apparent from this study that a single measure of improvement of dysarthria is too limiting; both the articulation measures and judgments of speech adequacy were necessary to assess the effects of stimulation. No doubt sound proficiency is the prime contributor to speech adequacy, but global measures of speech are needed to provide an index of the extent of impairment of oral communication. Even these two measures may not fully assess the level of sommunication. Some of the judges who have worked with the cerebral palsied noted that they employ visual lip-reading cues to understand the severely involved cerebral palsied child; others noted that the facial grimaces and involuntary movements of the cerebral palsied child often were distracting and diminished the communication as compared to judgments of speech adequacy based on tape recordings of speech. Possibly, future studies of dysarthria in cerebral palsy should employ audio-visual evaluation techniques.

A crucial issue concerns the child's ability to project an improved motor pattern for speech when more than relatively short and discrete responses are required. Projecting complex motor patterns over long time durations apparently may be another matter than brief imitation. A third issue involves the ultimate effects of aural-visual stimulation to speech behaviors that are under a program of operant control wherein schedules of rewarding reinforcement are applied to correct imitations. The results of work by McLean (1969) in improving the articulation of mentally retarded children without gross motor impairment suggest techniques that might be fruitful with the cerebral palsied. A program of organized research to explore these critical variables is now being planned.

APPENDIX A Sample of Rating Score Sheet for Judgments of Speech Adequacy

SPEECH RATING FORM

CODE NUMBER: DATE:

Excellent Superior	Good	Above Average	Average	Below Average	Poor	Completely Inadequate

Why

Dish

So

Kitten

Why

Dish

So

Kitten

Why

Dish

So

Kitten

APPENDIX B Instructions to Judges on Scale of Speech Adequacy

The recording which you will hear is made up of speech samples composed of words taken from 22 subjects. You will hear a set of four words at a time. Each set of four words will be uttered three times in the same order, resulting in twelve words per subject. The examiner will say the cue word, followed by the subject's utterance of the same word. It is your task to evaluate the general speech adequacy of <u>each single word</u>. Often the responses are uttered very rapidly, your scoring must be computed quickly. The tape will be stopped after each set of four words to provide more time for scoring. This means you are to decide how effective each utterance would be in an every day communication situation in which the listener did not know the speaker. General speech adequacy includes articulation, pitch, quality, intensity, rate and rhythm of speech. Your rating reflects the total effect of the person's speech.

Rate each speaker on the scale provided using the descriptive words and phrases as guidelines. Make your ratings only at the specific points or mid-points shown on the scale.

Each speech sample is preceded by a recorder code number. Please check that the code number in the upper left hand corner of your rating sheet and the code number uttered on the tape are in agreement.

OCCASIONALLY, A SPEAKER WILL NOT IMITATE THE WORD CALLED FOR BY THE EXAMINER. PLEASE RATE THIS AS INADEQUATE EVEN THOUGH THE SPEECH PRODUCTION MIGHT OTHERWISE RECEIVE A HIGHER RATING.

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