A COMPARISON OF THE EFFECTS OF AN INTEGRATED AURAL REHABILITATION PROGRAM*

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INTRODUCTION

The area of aural rehabilitation for the hearing impaired adult is an area rich in philosophies, opinions, and haphazard therapy techniques, but lacking in carefully controlled research. Much of the training suggested seems to follow the old adage, "Practice makes perfect." The vital factor in any aural rehabilitation program is the degree of improvement that occurs because of that program (O'Neill and Oyer, 1961). In order to effectively evaluate the effects of aural rehabilitation therapy, tests must be developed to assess speech discrimination and speech reading ability, or both, at the beginning of a therapy program, at the various stages (levels) within the therapy program, and at the completion of such a program. In addition, specific areas of communication difficulty can be recognized through these tests and performance can be evaluated in terms of the nature of improvement (auditory, visual, and audio-visual) and degree of improvement.

A considerable amount of clinical evidence is available to support the contention that speechreading and auditory training are worthwhile therapeutic procedures. However, there is a dearth of experimental evidence concerning specific attempts to evaluate certain materials or therapy techniques.

Aural rehabilitation should be approached with a definite orientation and with definite goals. The combined use of visual and auditory modalities in aural rehabilitation seems to be an established, if not necessary approach. In theory, many would agree to the benefits of the combined use of visual and auditory modalities in the aural rehabilitation of adults, but many therapists stress only one form of rehabilitative approach. Auditory training is neglected, which results in lipreading becoming the major therapeutic technique. The existence of residual hearing is accepted, but very little auditory training is provided (O'Neill and Oyer, 1961).

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All hard-of-hearing persons have some residual hearing. Aural rehabilitation work should be directed toward the use of residual hearing and not toward the recognition of speech through inaudible presentations as is usually the case with speechreading therapy. It is apparent that certain speech sounds which are difficult to identify by speechreading are relatively easy to hear, while other sounds, difficult to hear for the hearing impaired, can be recognized by observing the movement of the lips. Because of this, the combined auditory and visual cues supply most of the information necessary to understand speech, and what they lack is usually supplied by contextual clues. This is not a new discovery, but is a practical fact known to most hard-of-hearing individuals and to all properly trained professionals in the field (Duffy, 1969).

Hutton, Curry, and Armstrong (1959) developed a series of testing materials to be used in evaluation of auditory, visual, and combined auditory-visual discrimination ability. The authors reported that a combined score gave a better indication of the benefit the subject gained from visual clues than did the visual score alone.

In spite of the theory of combined practice in training, even O'Neill and Oyer, who support a combined approach, suggest that the initial stages of aural rehabilitation, the speech materials should be presented inaudibly so that the hard-of-hearing person can focus his attention on the visual aspects of speech. This seems to contradict the limited research that is available on the subject as well as the philosophy of the "combined approach."

It was the purpose of this study to develop a method of evaluation to determine the effects of aural rehabilitation for a group of hard-of-hearing adults. The therapy program was based upon available research and followed a combined speechreading and auditory training approach. The project was developed to serve as a pilot study for future research. A major goal was to establish the worth of aural rehabilitation for adults. It has not been shown experimentally that improvement actually occurs because of an integrated rehabilitative program. This may be due to inappropriate testing methods and materials, or it may be due to no improvement in communicative ability.

More specifically, this study was designed to answer the following questions:

(1) Will there be a significant improvement in speech discrimination scores following an integrated aural rehabilitation therapy program?

(2) Will there be significant differences between the mode of stimulus presentation, i.e., auditory versus audio-visual?

(3) Will there be significant differences for the type of stimulus materials employed (monosyllables and sentences)?

METHOD

Subjects

A group of five hearing impaired adults (2 males and 3 females) served as subjects for this study. The only requirements were that they be referred for aural rehabilitation as the result of recent audiometric testing at the Purdue University Speech and Hearing Clinic and that they agreed to attend the rehabilitation sessions regularly.

Test Materials

The monosyllables were taken from a list of N. U. Auditory Test No. 6 words (Tillman and Carhart, 1966). The sentences consisted of two ten-sentence lists from the Revised CID Everyday Speech Sentences (Hood and Dixon, 1969). Four listening sets were included in the test design in the following order:

(1) monosyllables presented auditorily,

(2) monosyllables presented audio-visually,

(3) sentences presented auditorily, and

(4) sentences presented audio-visually.

A video tape recorder (Ampex, VR-7000) was used to tape the test materials. The video image consisted of a full-face view of an adult female speaker. Each stimulus item was introduced with the carrier phrase "Write the word _____" or "Write the sentence _____." Attempts were made to monitor the last word in the carrier phrase to 0 dB on the VU meter of the group hearing aid (Grason-Stadler, Model 260 BU) that was used to present the auditory signals of the test material. Intensity fluctuations were within $\pm$ 2 dB for the

monitored words. The subjects were informed of the next test item by seeing the appropriate number on the TV monitor as well as hearing the speaker read the correct number. A response time of five seconds for each monosyllable and 30 seconds for each sentence was included in the tape.

Test Presentation

The auditory signal was fed from the video tape recorder (Ampex VR-7000) to high fidelity earphones through a Grason-Stadler group auditory training unit. The intensity of presentation to the test earphones was adjusted by means of individual control boxes. Each subject was instructed to adjust the intensity to his most comfortable listening level while listening to continuous discourse monitored at the same intensity as the test materials.

The video signal was fed from the video tape recorder to a TV monitor (Conrac, 23" screen). The television monitor was situated approximately eight feet from the subjects. The video image was turned off during the auditory sections of the test. The test was designed to be used with an open response mode. The subjects recorded their responses on appropriate answer sheets. Extra time was allowed when necessary.

Integrated Rehabilitation Program

Following the pre-test, the subjects attended six weeks of speechreading and auditory training sessions which met once a week for one hour. An integrated approach was stressed. Material for the lessons was based upon the Nitchie approach to lipreading and Kelly's Clinician's Handbook for Auditory Training. Practice therapy items were presented both in quiet and in the presence of noise. Upon completion of the six-week program, the speech intelligibility test was readministered to serve as a post-test in order to evaluate changes in performance following the rehabilitation program.

Scoring and Analysis of Data

The test items were scored in terms of total number of correct responses. Analysis of variance for repeated measures allowed for comparison of scores before and after training, comparison of the different stimulus materials, and comparison of modes of stimulus presentation. The Newman-Keuls method was applied to test the differences between all possible pairs of total scores. Differences were considered to be statistically significant if they reached the .05 level of confidence.

RESULTS

The following questions were considered in the analyses of data:

(1) Will there be a significant improvement in speech discrimination scores following an integrated aural rehabilitation therapy program?

(2) Will there be significant differences between the mode of stimulus presentation, i.e., auditory versus audio-visual?

(3) Will there be significant differences for the type of stimulus materials (monosyllables and sentences)?

Comparisons of treatment (pre-test versus post-test), mode of stimulus presentation (auditory versus auditory-visual), and stimulus materials (monosyllables versus sentence) were made by means of the analysis of variance for repeated measures (Winer, 1962). Table 1 shows the summary for the analysis of variance and demonstrates that significant differences occurred among the three elements included in this study. Since a significant F ratio was obtained, the Newman-Keuls procedure was applied to test the difference between all possible pairs of total scores.

TABLE 1

ANALYSIS OF VARIANCE

Source of Variation	SS	df	MS	F
Between subjects	629.35	4		
Within subjects	2923.75	35		
Conditions	2119.50	7	302.78	10.54*
Residuals	804.25	28	28.72	
TOTAL	3553.10	39		

*Summary of analysis of variance - demonstrates that significant differences occurred among the elements included in this study. .05 with 7 & 28 df = 2.36.

Comparisons of differences between pairs of scores are shown in Table 2. As seen in this table, the post-test score for auditory presentation of monosyllables (188) was significantly higher than the pre-test score (130) for the same type of stimulus material. However, no significant differences were found for pre-test and post-test comparisons for audio-visual presentation of monosyllables and sentences and for audio presentations of sentences.

Further inspection of Table 2 reveals that there were significant differences between auditory and audio-visual presentations of monosyllables in the pre-test condition. The pre-test score for monosyllables presented audio-visually (190) was significantly higher than the pre-test score (130) for the same type of stimulus material. However, no significant differences at the .05 level of confidence were reached between auditory and audio-visual scores. Similar comparisons of audio-visual and auditory presentation for either the pre-test or post-test condition failed to reach statistical significance. The high pre-test scores did not allow room for significant differences for the post-test scores.

TABLE 2

TESTS ON DIFFERENCES BETWEEN PAIRS OF SCORES

	Pre M(A)	Post M(A)	Pre M(A-V)	Post M(A-V)	Pre S(A)	Post S(A)	Pre S(A-V)	Post S(A-V)
	130	188	190	216	224	230	243	244
130	--	*	*	*	*	*	*	*
188		--	NS	NS	NS	*	*	*
190			--	NS	NS	*	*	*
216				--	NS	NS	NS	NS
224					--	NS	NS	NS
230						--	NS	NS
243							--	NS
244								--

*Significant at .05 level of confidence

A Auditory
M Monosyllables
S Sentences
A-V Audio-Visual
NS Not significant

Finally, comparisons between stimulus materials were made by considering performance scores for monosyllables and sentences when the mode of presentation was held constant. The following specific comparisons were made:

(1) pre-test scores for monosyllables and sentences presented auditorily

(2) post-test scores for monosyllables and sentences presented auditorily

(3) pre-test scores for monosyllables and sentences presented audio-visually

(4) post-test scores for monosyllables and sentences presented audio-visually

Table 2 shows that significant differences were found for the comparisons of conditions 1-3 listed above. In all cases, better speech discrimination scores were found when sentences were used as the stimulus material. Condition 4 did not reach statistical significance.

DISCUSSION

The greatest difference between pre-test and post-test scores was for monosyllables presented auditorily. The total score on the pre-test for monosyllables was quite low, allowing for greater opportunity for improvement than did the other pre-test scores. This indicates that it was the most difficult task under consideration. Generally the scores following the aural rehabilitation program resulted in a trend toward greater speech discrimination ability, although they did not reach statistical significance. This trend toward improvement was supported by sbujective evaluation by the subjects. Each subject was asked to discuss the results of the therapy program in terms of what he thought he got out of it and how he thought he had performed on the tests. All subjects reported a noticeable improvement in communication ability but were not sure the tests would actually reflect an improvement. Several subjects reported that the test items were "easier to hear" in the post-test, even though intensity was adjusted individually to the most comfortable listening level for both the pre-test and the post-test.

The greatest difference between auditory and audio-visual presentation was for monosyllables in the pre-test condition. This supports the finding reported previously, in that

low scores for auditory presentations allowed for greater opportunity to improve. Apparently, the lower the auditory score the greater the need to utilize visual cues and the corresponding ability to do so. Similarly, the lower the auditory score the greater the opportunity to demonstrate the effects of training. This seemed to be the case in the present study. Future studies should consider the possibility of presentation of materials in the presence of a competing signal such as white noise or speech noise. It is suggested that articulation functions be constructed for sentences presented auditorily and audio-visually, both in quiet and in noise for normal hearing and hearing impaired individuals.

It appears to the writer that these results have important implications for speech discrimination testing and the need for further research in the area of adult aural rehabilitation. For example, the recommendation for aural rehabilitation is frequently based on a client's SRT and more commonly on his speech discrimination score. In this study the lowest score was for monosyllables presented auditorily. When an individual received an audio-visual presentation of monosyllables, his score was significantly better than for a strictly auditory presentation. This finding suggests that each individual was already utilizing cues even though no formal speechreading training had been received. It seems that a more accurate estimate of an individual's communicative ability could be drawn from audio-visual presentation of clinical speech discrimination tests and if these tests consisted of sentences rather than monosyllables. Additional information concerning how the subjects in this study could be expected to handle everyday speech was obtained when sentences were used as the stimulus materials. The scores for sentences were consistently better than those obtained for monosyllabic words, regardless of auditory or audio-visual presentation both in pre-test and post-test conditions. It would appear, therefore, that the use of sentences as the stimulus material in diagnostic testing and in aural rehabilitation programs should be explored further, in quiet and in the presence of competing signals.

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