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Efficacy of Audiologic Rehabilitation for Older Adults

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Abstract

Two intervention procedures for the rehabilitation of elderly adults with hearing impairment were evaluated: analytic auditory training and active listening training. Seventy-eight older adults with hearing loss served as subjects. Twenty-six subjects received no training, 26 received analytic training, and 26 received active listening training. The effectiveness of the audiologic rehabilitation programs was determined via measures of speech recognition, hearing handicap perception, and psychosocial function. Active listening was found to be an effective treatment for helping individuals with hearing impairment improve their auditory-visual recognition of speech in noise and improve certain aspects of their psychosocial functioning. Support for analytic speech recognition drills alone was not demonstrated.

Key Words: Audiologic rehabilitation, elderly, hearing handicap, speech perception

Documentation of the efficacy of audiologic rehabilitation for adults with hearing impairment has received increased attention in the past decade. Audiologic rehabilitation efficacy research has focused on five areas: hearing aid benefit (e.g., Newman and Weinstein, 1988; Malinoff and Weinstein, 1989; Mulrow et al, 1992); hearing aid orientation (e.g., Kapteyn, 1977; Surr et al, 1978; Brooks, 1979, 1989; Ward and Gowers, 1980; Ward, 1981); perceptual training (e.g., Walden et al, 1981; Lesner et al, 1987; Rubinstein and Boothroyd, 1987; Smaldino and Smaldino, 1988; Gagné et al, 1991; Kricos et al, 1992); listening training (e.g., Rubinstein and Boothroyd, 1987; Kricos et al, 1992); and counseling-based programs (e.g., Abrams et al, 1992).

Two primary means of documenting audiologic rehabilitation treatment effects have been to determine whether the psychosocial effects of hearing impairment have been decreased and whether speech perception performance is improved as a result of treatment. Abrams et al (1992) addressed the issue of whether short-term counseling-based programs are effective in reducing perception of hearing handicap. Using the Hearing Handicap Inventory for the Elderly (HHIE) (Ventry and Weinstein, 1983), they demonstrated a significant reduction in degree of perceived handicap in a group of patients who had received hearing aids and a 3-week counseling-based program of audiologic rehabilitation. A second group who received hearing aids with no training also had a significant reduction in perceived handicap, although not as great as the group receiving training. A control group that did not receive hearing aids or audiologic rehabilitation exhibited no change in degree of perceived handicap.

Kricos et al (1992) examined the efficacy of a communication training program for elderly adults with hearing impairment. An experimental group received a 4-week communication training program that emphasized the comprehension of the general meaning of spoken messages by using situational and linguistic cues. A control group received no training. Results revealed significant reduction in self-perceived hearing handicap and slight but significant improvement in speech recognition ability for all subjects. The evaluation measures did not reveal a difference between the experimental and control groups. The results highlighted the need for continued research into reliable validation measures for documenting the effectiveness of

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audiologic rehabilitation and for the inclusion of a control group.

Walden et al (1981) studied 35 first-time hearing aid users who had no previous training. After pretesting, the control group received a 2-week standard hearing aid orientation. The auditory and visual training groups received 7 hours of analytic consonant recognition training beyond the standard hearing aid orientation. Aided pre- and post-test results using an auditory consonant recognition test suggested that, although subjects in all three groups increased their scores, subjects receiving individual consonant recognition training (auditory or visual) improved significantly more than those receiving just the 2-week standard orientation.

Rubinstein and Boothroyd (1987) also demonstrated significant improvement in speech recognition following auditory training. They studied 20 older adults with mild to moderate sensorineural hearing loss. Each subject's speech recognition was tested at the beginning of the study, after 4 weeks of no treatment, after 4 weeks of auditory training, and after a final 4 weeks of no training. The tests included a nonsense syllable test (NST) (Resnick et al, 1975), the low predictability portion of the Revised Speech Perception in Noise (RSPIN) test, and the high predictability items of the RSPIN test (Bilger, 1984).

Results indicated that auditory training, both synthetic and combined synthetic analytic, resulted in statistically significant improvement in speech recognition performance on the high predictability RSPIN test items (approximately 10% for both the synthetic only and synthetic-analytic groups). The gains achieved were not lost in the month following the end of training.

The improvements in speech recognition performance were modest in most cases and significant improvement was noted in only one of the three speech recognition measures. The authors could not determine if ineffective treatment methods or an insensitive measuring tool were responsible. Further, a wide range of improvement among subjects was seen.

The present study was designed to determine the efficacy of audiologic rehabilitation using measures of speech recognition, self-perceived hearing handicap, and psychosocial status. Although Rubinstein and Boothroyd (1987) documented the improvement of speech recognition following auditory training, we were interested in determining whether the negative psychosocial effects of hearing impairment could be reduced as a result of audiologic rehabilitation.

We evaluated two intervention procedures for the rehabilitation of elderly adults with hearing impairment: analytic auditory training and active listening training. Analytic auditory training involved structured syllable drill, aimed at improving the recognition of individual consonants and vowels (Walden et al, 1981). Active listening training, in contrast, emphasized the comprehension of the general meaning of spoken messages, using linguistic and situational cues, rather than concentrating on accurately identifying individual consonants and vowels (Kricos et al, 1992). The effectiveness of these audiologic rehabilitation procedures was systematically evaluated using pre- and post-treatment speech recognition measures, psychosocial assessments, and hearing handicap scales.

We compared three groups of older adults with hearing loss. Two groups received audiologic rehabilitation training and the third group acted as controls. For each group, pre- and post-training assessments were compared. The following hypothesis was tested: there are no significant differences between the experimental and control groups in pre- and post-training measurements of speech recognition abilities, self-rated communication handicap, and psychosocial status of subjects.

METHOD

Subjects

Seventy-eight adults with sensorineural hearing loss between the ages of 52 and 85 years served as the subjects. Twenty-six subjects received no training, 26 received analytic training, and 26 received active listening training. The subjects were obtained from the clinic population at the University of Florida Speech and Hearing Clinic, the University of Florida Medical Center, and various private clinics in central Florida and were paid $5 a session for their participation. All subjects had bilateral sensorineural hearing losses with pure-tone thresholds no better than 40 dB HL at 1000 or 2000 Hz in the better ear (Ventry and Weinstein, 1983) and a significant handicap (score of 12–40) as measured by the Hearing Handicap Inventory for the Elderly — Screening Version (HHIE-S) (Lichtenstein et al, 1988). All subjects were native English speakers with adult-onset hearing impairments. All subjects were hearing aid users, fitted with amplification prior to placement in a control or experimental group. None of the subjects had a previous history of stroke, a diagnosed terminal illness, or senile dementia. Subjects were required to have 20/40 corrected binocular vision, as measured by a Titmus Vision Screener. Every subject was tested with standard audiometric measures for each ear via headphones, using a Madsen audiometer in a sound-treated room. All control subjects were given the option to receive a similar program of audiologic rehabilitation following the completion of the study.

The 78 subjects were assigned on a rotating basis to one of three groups: a control group and two treatment groups. Pretraining scores from the CST, HHIE, and CPHI evaluations, as well as demographic factors (gender; age; years of hearing aid experience; monaural vs binaural fitting; the 1000, 2000, and 4000 Hz pure-tone averages; and the 500, 1000, and 2000 Hz pure-tone averages), were compared across the three subject groups to assess the balance and success of the randomization process. Quantitative baseline factors were examined graphically using scatterplots and boxplots and by comparing group means and standard errors. Qualitative baseline factors (e.g., gender, monaural vs binaural fitting) were examined by comparing group percentages. The three training groups appeared to be well balanced with regard to factors such as age, gender, hearing loss, and hearing aid experience, as well as pretraining scores from all evaluations. Proportions of males and females and proportions of side and number of ears aided were similar across the three groups. Therefore, the random assignment yielded groups that were evenly distributed on the basis of age, gender, hearing loss, and hearing aid experience (Table 1).

Table 1 Demographic Information: Age, Gender, Pure-tone Averages, and Years of Hearing Aid Experience of Subjects

	Control	*Analytic*	*Active Listening*	*Total*
Gender				
Females (n)	10	11	9	30
Males (n)	16	15	17	48
Age (yr)				
X	69.3	70.5	70.6	70.1
SD	7.6	6.9	6.4	6.9
PTA 512				
X	39.9	41.0	42.4	41.1
SD	15.7	15.9	15.1	15.4
PTA 124				
X	53.0	55.2	53.7	53.9
SD	14.3	16.0	12.2	14.1
HA EX (yr)				
X	9.0	7.9	6.7	8.0
SD	9.5	6.6	6.5	7.5

PTA 512 = pure-tone average for 500, 1000, and 2000 Hz in dB HL; PTA 124 = pure-tone average for 1000, 2000, and 4000 Hz in dB HL; HA EX = hearing aid experience in years.

Pre- and Post-Training Evaluations

Each subject received two complete evaluations: (1) 1 week prior to the treatment programs (pretreatment), and (2) 1 week after the treatment programs (post-treatment for the experimental training groups). Each evaluation was completed in a single test session with breaks given whenever necessary. The order of tests was counterbalanced. In each case, the evaluator was different from the clinician who performed the training sessions. The evaluations consisted of the following measures:

1. Speech recognition ability: The Connected Speech Test (CST) (Cox et al, 1987, 1988, 1989), a speech recognition test combining connected discourse and key word recognition, was administered using the commercially available videodisc recordings. This test utilizes 48 equivalent passages, each containing 25 key words. CST passages were presented in groups of six via videodisc in a speech-to-babble (S/N) ratio sufficient to yield 50 percent comprehension of the passages, using the adaptive procedure suggested by Danz and Binnie (1983) and Speaks et al (1972). The signal was presented in sound field at a 50 dB HL and the background noise was systematically adjusted using 5-dB steps in order to find the S/N ratio that yielded a 50 percent comprehension score. Subjects wore their own amplification, which was checked at the beginning of each test session. Comparisons of pre- and post-training S/N ratios needed to achieve 50 percent comprehension of the key words in the passage groups were made.
2. Hearing Handicap Inventory for the Elderly: The HHIE is a tool that measures the perceived social/situational and emotional effects of a hearing impairment experienced by older adults. The HHIE is a 25-item self-assessment inventory composed of a 13-item emotional subscale and a 12-item social/situational subscale. The HHIE was given to each subject in a face-to-face interview format. This format was chosen because research by Weinstein et al (1986) showed

higher test–retest correlations for this format compared to a paper and pencil format.

3. Communication Profile for the Hearing Impaired: In order to evaluate the psychosocial status of each subject, the Communication Profile for the Hearing Impaired (CPHI) (Demorest and Erdman, 1987) was administered to all subjects pre- and post-treatment using a face-to-face interview format. The CPHI was originally designed to be used in a paper and pencil format. However, we chose a face-to-face interview format to provide consistency of administration with the HHIE. The CPHI is a 145-item self-assessment inventory that consists of 25 subscales addressing many of the behavioral, attitudinal, and emotional factors that may have positive or negative effects on communication for those with hearing impairment. Nearly half of the CPHI items concern personal adjustment. The CPHI enables quantification of an individual's adjustment to having a hearing loss.

Procedures

Each subject in the treatment groups was seen individually for 1 hour, two times a week for the 4 weeks of the treatment program. A description of the specific procedures for each experimental group is as follows:

1. Analytic auditory training. The authors replicated Walden et al's (1981) analytic auditory speech recognition training to determine the feasibility of this training paradigm for improving the speech recognition abilities of older adults with hearing impairment. The Walden et al (1981) program consisted of a series of analytic consonant discrimination exercises that became progressively more difficult. During each exercise, subjects were required to make same-different judgments between syllable pairs and to identify nonsense syllables presented individually. The primary training technique involved 100 percent feedback of the correctness of subject responses, with repetition of all incorrect responses. Audiovisual feedback was provided for all subject responses. These training procedures permitted hundreds of syllables in the /vCv/ context to be presented for discrimination and identification during a single training session.

   All consonant drills were provided live-voice on an individual basis. During auditory training, the clinician's lips were concealed as syllables were presented to eliminate visual cues. Training stimuli were presented in a quiet voice with the subject's hearing aids adjusted to a comfortable listening level for this sound level. Varying levels of multitalker background noise were used during the drill work.

2. Active listening training. An active listening approach to audiologic rehabilitation was developed by the authors that trains the individual to recognize the meaning of the message itself rather than individual consonants. This training emphasized coping strategies to enable the elderly adult with hearing loss to comprehend the meaning of what was being said, when only part of it is actually heard. The goals of training were to develop good listening habits to increase the subjects' confidence and to help them concentrate more on the meaning of the spoken message. Nonverbal and situational cues were stressed, as well as information regarding modifications of the daily home environment to facilitate listening abilities. A method of message confirmation and expression called reflective listening (Guerney, 1977) was also taught. The purpose of reflective listening is to develop attitudes and skills that will enable the person to communicate to others in ways that will maximize the satisfaction of emotional and functional needs. They were taught the following modified guidelines from Guerney (1977), using listening drills and discussion materials:

   1. Listen intently.
   2. Show interest and understanding while others are talking, with eye contact and body language.
   3. Absorb the other's mood and put yourself in the other's place.
   4. Use closure and guessing skills to fill in the blanks for words not heard clearly.
   5. Formulate a statement summarizing the speaker's statement.
   6. Accept corrections readily.
   7. Use coping strategies to resolve communication blockages, including strategies such as repeating, rephrasing, confirming, etc.
   8. Disregard noise.
   9. Do not give up prematurely.
   10. Analyze errors in listening strategy.

The subjects were also taught expressive skills that were designed to help them communicate their needs to others in an assertive, nonthreatening manner. Speech tracking was used for practicing these skills (De Filippo and Scott, 1978). Tracking is a procedure in which subjects are presented with prose and asked to repeat verbatim what they hear. Repair strategies, such as "Say it again," "Spell that word," are used to resolve communication breakdowns (Owens and Raggio, 1987; Erber, 1988). Subjects wore their hearing aids during all listening exercises. Varying levels of multitalker noise were used during listening exercises.

RESULTS

An analysis of covariance (ANCOVA) model was used to compare group post-training scores for each of the CST, HHIE, and CPHI variables because, generally, simple differences between pretreatment and post-treatment scores are likely to be correlated with pretreatment scores. The pretraining score for a given evaluation variable was thus maintained in the model at all times as an independent covariate. Dependence of the magnitude of group differences in post-training scores on the level of pretreatment scores was assessed first by F-ratio testing for a group by pretraining score interaction effect in the model. In the absence of a statistically significant interaction effect, the ANCOVA model was refit without the interaction term and the F-ratio was tested for a significant adjusted group main effect.

For variables that demonstrated significant overall group main effects only, T-ratios of the specific analytic group versus control and active listening group versus control effects to their standard errors were estimated and tested for significance. For variables that demonstrated a significant group interaction with pretraining scores, the analytic group versus control and the active listening group versus control 'difference curves' with 95 percent confidence bands were estimated over the range of observed pretraining scores (Fleiss, 1986). The analytic group or active listening group post-training scores will differ significantly from control scores above or below the pretraining score at which these confidence bands begin to exclude zero. The subject demographic factors were considered singly as additional independent covariates in the interaction and main effects ANCOVA models in order to assess the validity of results obtained from the simpler models. The magnitude, scale, and statistical significance of group interaction and main effects estimated by the augmented and simpler models were compared for each variable.

Statistical Analyses of the Experimental Hypothesis

For each group, pre- and post-training assessments were compared. Each training group was also compared to a separate control group. Recall that the following hypothesis was tested: there are no significant differences between the experimental and control groups in pre- and post-training measurements of speech recognition abilities, self-rated communication handicap, and psychosocial status of subjects. The results for each of these measures will be discussed separately.

Speech Recognition. For each subject, the S/N ratio, expressed in dB, sufficient to yield 50 percent comprehension of connected discourse (CST passages), was obtained for two conditions: auditory only and auditory visual. These measurements were obtained 1 week prior to training (pre) and 1 week following the treatment protocol (post). Better performance is reflected by S/N ratios that are lower, indicating that the subject could comprehend the speech even in louder background noise fields. Considerable variability was noted among and within all three subject groups, as indicated in the scatterplots shown in Figures 1 and 2. Table 2 shows the means and standard deviations for the three subject groups in two conditions, pre- and post-treatment. An improvement can be noted in the pre to post means in all three groups for both conditions. The large standard deviations highlight the subject variability.

Statistical analysis of these speech recognition results, however, indicated no significant main effects or interactions for the auditory-only condition (Fig. 1). For the auditory-visual condition, a significant interaction of groups by pre-post measures was found ($p < .05$). For the active listening group, the S/N ratio obtained during pretesting had a significant effect on the amount of change in the postscore. This effect is obvious upon examination of Figure 2. That is, if a high pretest score (poor speech recognition in noise abilities) was obtained for an active listening subject, that subject was likely to show considerable improvement on the post-test. On the other hand, low (better) pretest scores usually resulted in no change in post-test scores. No

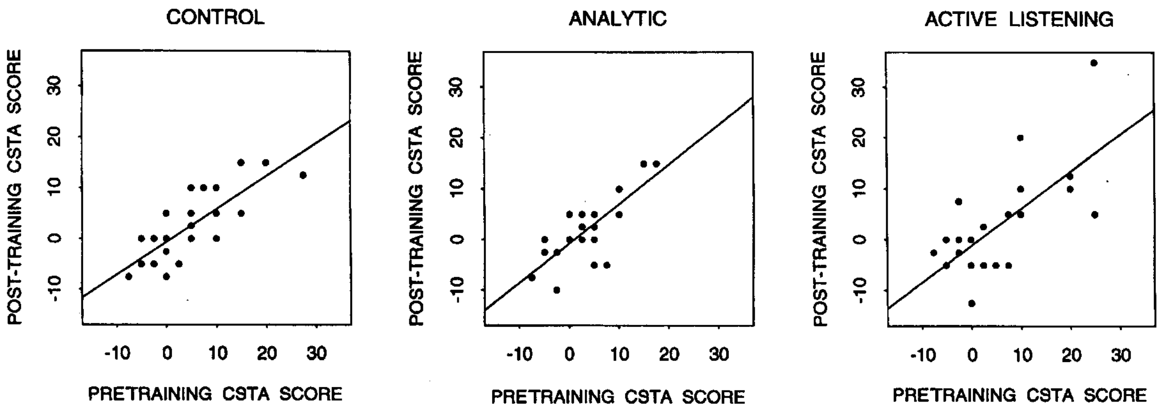

Figure 1 Scatterplots of pretraining vs post-training CST auditory-only (CSTA) scores for the three subject groups. The CSTA scores are the S/N ratios that yielded 50 percent correct speech recognition. A given point may represent more than one subject.

significant effect was found for the analytic or control groups.

HHIE. Scores on the HHIE could range from 0 to 100, with higher scores indicating a greater amount of perceived handicap. The scores were divided into two subscales (emotional and social). Table 3 summarizes the HHIE data obtained from the three groups pre-and post-treatment. Statistical analysis indicated no significant main effects or interactions. Therefore, there were no treatment effects using the HHIE as a measure of self-rated communication handicap.

CPHI. Psychosocial status of the subjects was measured via the CPHI, a 145-item measure divided into 25 subscales (Table 4). Because the majority of subjects were retired, the two subscales dealing with work were omitted from the analysis. Table 5 shows the mean and standard deviation data for the three subject groups in the pre- and post-treatment conditions for the subscales yielding significant results. In Table 5, the results of the analytic group are included; however, no statistically significant differences between the analytic group and control group were detected for any of the evaluation variables considered in the study. For these subscales, higher scores indicate better communication or adjustment. None of the other subscales yielded significant main effects nor interactions.

Table 6 lists the evaluation variables with post-treatment scores that differed significantly in some manner between the active listening and control groups after controlling for respective pretraining score levels. The effect always represented an increase in the active listening group's post-training scores relative to control. For the

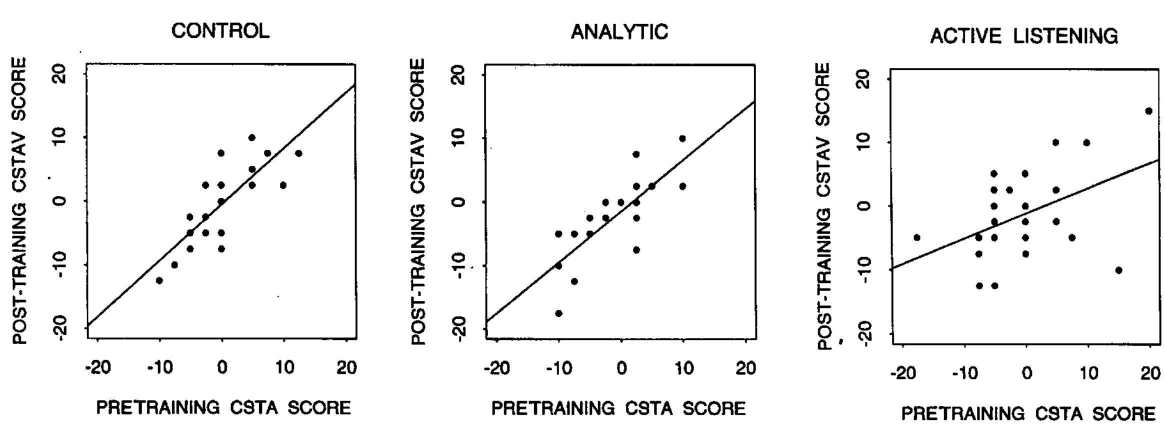

Figure 2 Scatterplots of pretraining vs post-training CST auditory-visual (CSTAV) scores for the three subject groups. The CSTAV scores are the S/N ratios that yielded 50 percent correct speech recognition. A given point may represent more than one subject.

Table 2 Means and Standard Deviations of the S/N for 50 Percent Comprehension of the Connected Speech Test across Three Subject Groups and Two Conditions Pre- and Post-treatment

	Auditory Only		*Auditory Visual*	
Group	*Pre*	*Post*	*Pre*	*Post*
Control	4.62	2.31	–0.67	–1.15
	(8.15)	(6.59)	(5.50)	(6.01)
Analytic	2.31	1.15	–1.15	–2.50
	(6.28)	(6.17)	(5.62)	(5.79)
Active Listening	5.29	2.60	–0.19	–1.35
	(9.01)	(9.63)	(7.71)	(6.90)

first three variables (verbal strategies, nonverbal, and behavior), a significant main effect for group was found with no overall group by pretraining score interaction. In other words, the active listening group had significantly greater improvement than the control group regardless of pretreatment scores. For the next four variables (attitude, acceptance, withdrawal, and problem awareness) with significant group by pretraining score interaction effects, differences in post-training scores between groups depended on pretraining scores. Estimates of the active listening group versus control effect are listed in Table 6 with 95 percent confidence intervals. For variables that demonstrated significant group by pretraining score interaction, the effect listed is the minimum estimated effect over the range of observed pretraining scores where the effect was found to be statistically significant. These ranges are listed in the last column of Table 6. For example, if an individual had a pretreatment score of less than 3.13 for the attitude subscale, significant improvement with treatment could be expected. On the other hand, if the pretreatment score was greater than 3.13, no significant improvement would be likely with treatment.

Table 3 Means and Standard Deviations of the HHIE Results for the Three Subject Groups, Pre- and Post-treatment

	HHIE Total		*HHIE Social*		*HHIE Emotional*	
Group	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Control	40.3	34.3	20.8	18.2	19.5	16.1
	(20.7)	(21.5)	(10.9)	(11.0)	(11.6)	(11.6)
Analytic	46.6	39.0	22.1	20.1	24.5	19.4
	(25.5)	(26.3)	(11.6)	(11.8)	(15.1)	(14.9)
Active Listening	37.4	30.4	18.8	16.8	18.6	13.6
	(18.4)	(19.1)	(7.8)	(9.6)	(11.5)	(11.0)

Table 4 Subscales of the CPHI

Communication Performance
- Social score
- Social importance
- Work score
- Work importance
- Home score
- Home importance
- Adverse conditions
- Average conditions
- Problem awareness*

Communication Environment
- Communication need
- Physical characteristics
- Attitudes of others*
- Behaviors of others*

Communication Strategies
- Maladaptive behaviors
- Verbal strategies*
- Nonverbal strategies*

Personal Adjustment
- Self-acceptance
- Acceptance of loss*
- Anger
- Displacement of responsibility
- Exaggeration of responsibility
- Discouragement
- Stress
- Withdrawal*
- Denial

*Statistically significant difference between pre- and post-treatment for the active listening group ($p < .05$).

Table 5 CPHI Means and Standard Deviations for the Three Subject Groups, Pre- and Post-treatment, for Subscales Yielding Significance

	Control		*Analytic*		*Active Listening*	
Subscales	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Attitudes of Others	3.89	3.91	3.74	3.66	3.77	4.03
	(0.58)	(0.54)	(0.77)	(0.83)	(0.67)	(0.47)
Behaviors of Others	3.80	3.73	3.80	3.72	3.74	4.08
	(0.66)	(0.63)	(0.59)	(0.66)	(0.52)	(0.52)
Verbal Strategies	3.16	3.22	2.96	2.89	3.04	3.61
	(0.64)	(0.70)	(0.92)	(0.87)	(0.81)	(1.00)
Nonverbal Strategies	3.80	3.73	3.74	3.79	3.63	4.20
	(0.68)	(0.67)	(1.06)	(0.98)	(0.89)	(0.75)
Withdrawal	3.23	3.33	2.86	3.08	3.19	3.41
	(0.90)	(0.91)	(1.05)	(0.96)	(0.68)	(0.60)
Problem Awareness	3.90	3.80	4.15	3.93	3.94	3.95
	(0.59)	(0.63)	(0.54)	(0.53)	(0.56)	(0.46)
Acceptance of Loss	3.68	3.78	3.57	3.57	3.92	4.11
	(0.63)	(0.60)	(0.97)	(0.95)	(0.61)	(0.49)

Table 6 Variables Demonstrating Significant Active Listening vs Control Effects on Post-training Scores in Univariate Analysis of Covariance Models

Variable	*Interaction p Value**	*Main p Value†*	*Active Listening vs Control Effect‡*	*95% Confidence Interval#*	*Range of Significance§*
Verbal Strategies	—	.0001	.49	(.18 .80)	Entire range
Nonverbal Strategies	—	.0009	.57	(.25 .89)	Entire range
Behaviors of Others	—	.004	.40	(.14 .66)	Entire range
Attitude	.0002	.0001	.44	(0 .88)	< 3.13
Acceptance	.003	.0006	.29	(0 .58)	< 3.54
Withdrawal	.031	.022	.49	(0 .98)	< 2.46
Problem Awareness	.049	.037	.44	(0 .88)	< 3.33

*ANCOVA p value for the overall training group x pretraining score interaction effect on post-training scores.
†ANCOVA p value for the overall training group main effect on post-training scores.
‡Estimated post-training score effect for active listening vs control. For variables demonstrating a main effect only, the listed value is the estimated active listening vs control effect over the entire range of observed pretraining scores. When group x pretraining score interaction is present, the listed value is the minimum estimated effect over the range of pretraining scores where the effect was found to be statistically significant. A missing value indicates that significant overall effects were observed but could not be attributed to a specific pairwise group effect.
#95 percent confidence interval for the listed active listening vs control effect.
§Range of observed pretraining scores over which the listed active listening vs control effect is statistically significant.

In order to determine if these statistically significant differences in performance represent meaningful clinical differences, we examined pre- and postscores for individual subjects within each group. There are no standardized CPHI data for the elderly population in general. However, using active duty military personnel, Demorest and Erdman (1988) examined the distribution of retest differences in order to determine clinical significance of changes in test scores. Table 7 shows the number of subjects in each group who showed clinically significant benefit from training using Demorest and Erdman's values for the 95 percent confidence interval. Note that substantially more active listening subjects showed clinically significant improvements. When looking at individual subjects, 22 of the 26 control subjects and 17 of the 26 analytic group subjects showed no clinically significant improvements on any tests. Conversely, only 4 of the 26 active listening group subjects did not show any clinically significant improvements.

Table 7 Number of Subjects in Each Group Who Showed Clinically Significant Benefit from Training

Subscale	*Control (n = 26)*	*Analytic (n = 26)*	*Active Listening (n = 26)*
Attitudes of Others	1/22	0/21	8/19
Behaviors of Others	0/21	3/25	9/24
Verbal Strategies	1/25	1/24	9/25
Nonverbal Strategies	0/18	5/16	10/16
Withdrawal	2/23	2/26	7/24
Problem Awareness	1/24	0/19	2/23
Acceptance of Loss	1/21	1/20	4/16

*Number is expressed as the proportion of subjects who showed significant benefit out of the number whose pretraining score was low enough to improve by the critical value proposed by Demorest and Erdman (1988).

Effect of Selected Pretreatment Factors on Group Post-training Score Differences

None of the subject demographic factors (gender; age; years of hearing aid experience; number of aided ears; 1000, 2000, and 4000 Hz pure-tone averages; and 500, 1000, and 2000 Hz pure-tone averages) or the degree of pretraining handicap perception (HHIE-T) altered the significance of overall effects on post-training scores for the variables listed in Table 6. In several instances, the specific active listening group versus control group effect became marginally significant when these covariates were placed in the ANCOVA model. For the most part, the magnitude and direction of estimated active listening group versus control group effects remained relatively unchanged after these covariates were added to the model. Years of hearing aid experience (see Table 1), although not significant as a covariate in the model, caused the training group versus control effect to change by as much as 0.15 post-training score units. The magnitude of the training group versus control effect tended to be greater with those subjects with less hearing aid experience. However, significiant differences among groups remained significant when this covariate was included in the analyses.

DISCUSSION

Since the early 1900s, there has been pervasive use of analytic and synthetic auditory training and lipreading for adults with hearing impairment (Silverman and Kricos, 1987). Walden et al (1981) were among the first to document the efficacy of any of these treatment approaches. Specifically, their results showed that analytic auditory training and lipreading were useful in improving speech recognition in noise for younger adults. However, they questioned the efficacy of their analytic approaches for older adults. Rubinstein and Boothroyd (1987) found modest improvements in speech recognition in 20 older adults using both purely synthetic and combined analytic and synthetic approaches.

In the present research, however, the efficacy of analytic auditory training for older adults with hearing handicap was not demonstrated. Subjects in the analytic group did not significantly improve in their ability to understand speech in a background of noise for either the auditory-only or the auditory-visual conditions. Our results appear to confirm the concern expressed by Walden et al (1981) regarding the suitability of analytic consonant training for older adults. Rubinstein and Boothroyd (1987) did not use a purely analytic approach in their study. The improvements noted in their combined approach may have been due solely to the synthetic component in their training protocol.

Additionally, subjects in our analytic group showed no significant improvement over the control group in hearing handicap or psychosocial status. This result is not surprising because our analytic training protocol was specifically designed to improve speech recognition with no counseling component to address the subject's psychosocial needs.

In the current study, the use of an active listening approach was proven to be an effective rehabilitation procedure for improving audiovisual speech recognition in noise. These results are in agreement with Rubinstein and Boothroyd (1987), who also found a modest improvement in speech recognition abilities after listening training. Because many older hearing-impaired adults report their greatest difficulties in understanding speech when background noise is present, this is an important finding.

In addition to improved speech recognition, the active listening group showed improvement in several aspects of psychosocial functioning, as measured by the CPHI. The results clearly demonstrated that the active listening group's scores on both the verbal and nonverbal strategies subscales improved. By using verbal and nonverbal strategies, the older adult with hearing impairment is able to communicate effectively even in adverse listening environments. Additionally, the active listening group indicated that they were now able to effectively change the behavior of others to improve their potential for successful communication. Improvement was noted in these variables (verbal strategies, nonverbal strategies, and behaviors of others), regardless of the pretraining score. These results provide evidence that active listening training will be beneficial to elderly individuals with hearing impairment.

For those individuals in the active listening group whose pretraining scores suggested greater difficulties or involvement for the subscales of attitudes of others, acceptance of loss, withdrawal, and problem awareness, improvements were also noted in these psychosocial areas. The poorer an individual's score in the pretraining testing, the more likely there will be significant improvement for these particular areas of psychosocial functioning. Therefore, the results suggest that if an individual shows evidence of problems in any of these four areas, an active listening treatment program would be of additional benefit, beyond the improvements noted above for verbal and nonverbal strategies and behaviors of others. These improvements in personal adjustment could be attributed to the individuals learning coping strategies to help them deal with communication breakdowns.

Although the efficacy of the active listening training approach was documented by the CPHI and by speech recognition testing, the HHIE failed to detect a significant difference between the control and the active listening training group. The HHIE was designed to determine the general degree of self-perceived handicap in social and emotional contexts. It provides an overview of how handicapped a person with hearing impairment feels. The CPHI, on the other hand, focuses not only on handicap perception, but also on communication strategies. Because of its detailed descriptors and exploration of a variety of communication environments and situations, the CPHI is a more sensitive measure of the effects of active listening training. The HHIE may be more useful for documenting the effectiveness of counseling-based programs, as shown by Abrams et al (1992), rather than of communication training programs. It should be noted, however, that

Abrams et al (1992) used new hearing aid users as subjects. The postintervention HHIE was administered 2 months after they received their hearing aids. In the current study, all subjects were experienced hearing aid users with a minimum of 9 months of hearing aid use (mean of 8 years for the total subject sample). Recall that the treatment effects found for the active listening group were more pronounced for those subjects with less hearing aid experience.

Individual variability was evident for all measures in all three subject groups, with some subjects showing more or less improvement than others. Speculated reasons for this variability include etiology of loss, age of onset, other health problems, motivation during therapy, support from significant others, and communication demands and opportunities. Subject variability in response to treatment has been documented in other studies (Bode and Oyer, 1970; Rubinstein and Boothroyd, 1987; Kricos et al 1992), but remains an enigma in need of further investigation.

In summary, active listening training was found to be an effective rehabilitation procedure for older adults with hearing loss, significantly improving both speech recognition and psychosocial functioning. Active listening significantly improved the older adults' abilities to cope with and assume responsibility for communication breakdowns, regardless of pretraining status. There may be additional benefits as a result of active listening training for older adults who exhibit problems with personal adjustment (e.g., acceptance of the loss, withdrawal), problem awareness, and negative attitudes of others toward the hearing loss.

CONCLUSION

This study of treatment efficacy yielded a number of interesting findings that will be useful to professionals who work with older adults with hearing impairment. Most importantly, active listening was found to be an effective treatment approach for helping individuals with hearing impairment deal with their communication handicaps. The analytic approach was not found to be useful for reducing the psychosocial handicaps accompanying hearing loss or in improving speech recognition for older adults. Support for inclusion of analytic speech recognition drills was not demonstrated.

Ross (1987) has stated that perceptual training would likely not be of benefit to a motivated hearing aid user at a noisy party. Rather, he suggested that the hearing aid user is most in need of strategies, rather than auditory perceptual drills, for resolving communication blockages. Additionally, he suggested adjustment counseling as a means to increase acceptance of the hearing loss and to encourage assumption of the responsibility for resolving communication difficulties. Our results would appear to confirm Ross's speculation regarding what works and what does not work for hearing-impaired adults.

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