Influence of Amplification on the Psychological Functioning of Older Adults with Neurosensory Hearing Loss

Carol J. Dye
Geriatric Research, Education and Clinical Center (GRECC)

Margaret F. Peak
Audiology and Speech Pathology Service
Veterans Administration Medical Center
St. Louis, Missouri

The present study explored the relationship of severity of hearing loss to psychological functioning pre- and post-amplification among older veterans in late middle age. Fifty-eight male veterans between the ages of 45 and 83 years, divided into two groups of "more" and "less" severe hearing impairment, were seen in the St. Louis VAMC Audiology Clinic, issued hearing aids, and given a battery of psychological tests to assess mood, memory and paranoia among other variables. Those individuals with more severe hearing loss were less alert to information from the environment, less capable at memory tasks and learning new material, more paranoid, depressed, and perceived themselves to be experiencing more problems in coping with the environment than those with a less severe loss. After 6 weeks of amplification, both hearing impairment groups showed improvement in psychological functioning and no significant differences between the groups on any of the psychological measures. It would seem, therefore, that the more severely impaired group showed greater improvement in functioning. The results of this study do not indicate the mechanism by which these effects occur, but seem to focus on the need to discover and rehabilitate hearing loss.

As people age the incidence of hearing loss and the effect of that hearing loss on life style causes increasing problems in communication. According to the 1976 Metropolitan Life Study, hearing loss increases from 4.2% for the population under age 44 to 11% for people 45-64 years and then doubles to

Carol J. Dye, Ph.D. is a clinical psychologist and gerontologist at the Veterans Administration Medical Center, Geriatric Research, Education, and Clinical Center (111G-JB), St. Louis, MO 63125. Margaret F. Peak, Ph.D. is an audiologist at the Veterans Administration Medical Center, Audiology and Speech Pathology Service (126-JB), St. Louis, MO 63125.

23% for the next age decade, 65-74 (Schow, Christenson, Hutchinson, & Nerbonne, 1978). The incidence of hearing loss in the veteran population is even greater than that found in the general population for the same ages, primarily due to noise exposure in combat and training for combat. As hearing loss increases, hearing handicap increases, but "there is an imperfect relationship between hearing handicap (however measured) and hearing impairment" (Ventry & Weinstein, 1983).

Loss of hearing is just one of the stresses with which an aging individual must cope. Existing in an increasingly silent or distorted world adds to the visual and sensory deficits, and constricted life space and social life of the aging population (Schow, Christenson, Hutchinson, & Nerbonne, 1978; Vargo, 1979; Ramsdell, 1970). Auditory impairment is an invisible disability which often has the effect of appearing to reduce the intellectual functioning of the sufferer. The invisibility of the handicap allows the hearing impaired to project the problems caused by the hearing loss onto the signal producer who mumbles or "doesn't speak up" rather than onto himself, the receiver (Vargo, 1979). Seeking help for hearing loss is often delayed until the problems resulting from the loss are greater than the perceived stigma of wearing a hearing aid or until others have urged the sufferer to seek help (Millin, 1979).

However, there are negative psychosocial aspects to wearing hearing aids that all too often prevent the hearing impaired person from seeking help or accepting the fact that a hearing aid will help him. Some of the major negative fallacies that lead to the non-seeking of hearing help are: (a) beliefs that only "old people" wear hearing aids, (b) hearing aids are large ugly boxes with cords that are very visible and inconvenient and advertise the problem, and (c) hearing aids can't help nerve deafness (Maurer & Rupp, 1979; Corso, 1977; Vargo, 1979). The stigma attached to wearing obvious hearing aids is still with us. Johnson, Danhauer, and Edwards (1982) reported that more people felt that a senior citizen looked older and also looked less communicatively effective when wearing a hearing aid. The size of the hearing aid had a significant impact on the judgments. Devices that do not focus attention, such as the custom in-the-ear aids, seem to be far more acceptable and have changed the focus of the hearing aid industry so that ease in wearability with effective cosmetic camouflage is a reality (Maurer & Rupp, 1979).

While hearing aids and the procedures and theories for dispensing them have been changing and improving over the last decade, the psychological consequences of doing without hearing aids by struggling to exist with hearing loss continues for the majority of the population. The psychological effect of hearing loss in aging has been postulated to be so devastating that it contributes to the development of negative personality characteristics and increased interpersonal conflict (Busse & Pfeiffer, 1973; Butler & Lewis, 1973). The development of paranoid tendencies has been especially pin-

pointed as a potential development in those who grow hard-of-hearing in old age (Busse & Pfeiffer, 1973). For example, hard-of-hearing people who may see that other individuals in the same room are talking, only hear a part of what is said, and assume that the other people are talking about them since conversational speech is perceived as whispering (Traynor & Hurd, 1980). Rousey (1971) discussed the influence of hearing impairment in the development of other psychological reactions such as feelings of rejection or defenses of denial, isolation, and projection.

There is some support for the hypothesis about the relationship between hearing loss and negative personality change in the results of a study by Eisdorfer (1960). Eisdorfer tested a group of older adults with the Rorschach Inkblot Technique and found that hearing loss was associated with negative scores on the test. Granick, Kleban and Weiss (1976) found that mild hearing loss was associated with increased suspiciousness. In the area of cognitive functioning, Smith and Fay (1977) found that some patients classified as having chronic brain syndrome simply had a long standing hearing loss. While Sklar and Edwards (1962) did not find a relationship between intellectual and personality functioning and levels of hearing loss in a group of men 65 years and older, Hine (1970) documented a direct relationship between hearing loss and a reduction in ability at verbal type functions among young people.

PURPOSES OF STUDY

The results of the above cited psychological studies seem to indicate that acquired hearing impairment may have psychological consequences for the individual afflicted, but they do not answer the question of whether the extent of a hearing deficit has a variable effect on psychological functioning; i.e., do individuals with more severe hearing loss show greater deficits in psychological functioning than individuals with milder levels of impairment? Another important question is whether these effects can be reversed if the individual obtains amplification. The present study was designed to determine whether the extent of hearing loss affects psychological functioning in the older adult and whether amplification can influence this functioning.

METHOD

Subjects

Subjects for this study were drawn from the general clinical audiological population of the St. Louis VAMC Audiology Clinic. Candidates for the study had to be at least 45 years of age and must never have worn hearing aids. Additionally, the candidates had to have adequate vision to read. The nature of the psychological test battery precluded the use of some

potential subjects, particularly those over 70, due to visual impairment. From the pool of veterans eligible for hearing aids and awaiting their initial hearing aid evaluation, 58 agreed to participate in the study. The mean age of the 58 subjects was 60.98 years with an age range of 45 to 81 years. The less severe hearing loss group had a mean age of 60.13 years (S.D. = 87.02 months). The more severe hearing loss group had a mean age of 61.6 years (S.D. = 85.22 months). The *t*-statistic testing differences in ages between these 2 groups was insignificant ($t = -2.16$). Fifty-three (91%) of the subjects were in the age range of 50-69.

The 58 subjects were dichotomized into 2 hearing impairment groups: more severe and less severe. Criteria for the less severe group were: pure-tone average no poorer than 35 dB HL, spondee threshold no poorer than 38 dB HL (ANSI, 1969), and the pure-tone threshold at 2000 Hz no greater than 75 dB HL. Criteria for the more severely impaired group were: pure-tone average greater than 35 dB HL (ANSI, 1969), spondee threshold 38 dB HL or greater. Subjects were assigned to either group based on pure-tone average and spondee thresholds. However, since most of these veterans had sloping losses and poor hearing at 2000 Hz, the speech discrimination scores affected group placement in that a "poor" speech discrimination score would drop a candidate from the "less" to the "more" severe group. The arbitrary cut-off for "good" speech discrimination scores was no poorer than 74% using a full list of W-22 words. Any subject meeting the "less" criteria whose score was at least 74% remained in the less group. If, however, the score was poorer than 74%, the subject was moved to the more severe group. The reverse did not hold true, however. If the pure-tone average and spondee threshold mandated assignment to the "more" group, a speech discrimination score in excess of 72% would not move the subject into the "less" group as the intensity level at which the discrimination stimuli were presented was routinely above the level of normal conversational speech.

Materials and Procedures

All audiometric testing was performed in a double-wall double-room IAC test suite (Model 1203) using a Grason-Stadler 1701 audiometer calibrated to ANSI 1969 standards. Spondee threshold and discrimination scores were established to taped stimuli (W-1 and W-22 from Auditec). Initial hearing evaluations were performed at either division of the St. Louis VAMC by certified staff audiologists. Psychological tests were administered under the supervision of the senior author (CJD) by a trained research assistant and were completed at the Jefferson Barracks Division of the St. Louis VAMC in the Hearing Aid Center. This examiner did not know of the hearing impaired group to which the veterans belonged until after they had completed their second testing. All psychological testing was performed in a moderately sound treated room with the subjects wearing their

hearing aids. Psychological tests were administered the day the subject received the aid (initial evaluation) and again 6 weeks later.

The psychological tests administered were the Information subtest of the Wechsler Adult Intelligence Scale (WAIS) (Wechsler, 1958), the Wechsler Memory Scale (WMS) (Wechsler, 1945), the Paranoia Scale from the Minnesota Multiphasic Personality Inventory (MMPI) (Dahlstrom, Welsh, & Dahlstrom, 1972), the Zung Self-Rating Depression Scale (SRDS) (Zung, 1965), the Trailmaking Test (Armitage, 1946), the Profile Questionnaire for Rating Communicative Performance (Sanders, 1975) and the Denver Scale of Communicative Function (Alpiner, 1975). The Information subtest of the WAIS was administered as a control for differences in level of intellectual functioning between the 2 hearing groups. The WMS was included as a test of various types of memory and other functions. The separate subtests tap orientation, mental concentration and attention, overlearned memory items, immediate auditory memory, visual spatial memory, and new learning and auditory memory of verbal material.

The Paranoia scale of the MMPI and the Zung SRDS were included to provide well known and clinically utilized assessments of their respective dimensions. The Trailmaking test assess lateralized brain functioning. The last 2 scales (Denver and Profile Questionnaire) assess different aspects of self perceived adjustment to hearing loss. For the first assessment, this battery of tests was administered on the day that the veteran was given and fitted with his hearing aid. The veteran wore his hearing aid during the testing. Then after the veteran had used the aid for 6 weeks, the same battery of tests was readministered. Again, the veteran wore his hearing aid for this assessment.

RESULTS

Audiological Measures

Mean pure-tone thresholds (Table 1) indicated that the major threshold differences between the groups occurred in the frequencies below 2000 Hz. Thresholds above 4000 Hz are not reported here as the groups had similar thresholds above 4000 Hz. The pure-tone threshold differences were accentuated by the differences in spondee thresholds and discrimination scores (Table 2).

Hearing Aid Fitting

All veterans in the study were fitted with VA contract hearing aids. The 58 veterans were fitted with 98 aids indicating that 40 of the 58 were fitted binaurally (Table 3). Each subject experienced binaural amplification but the choice of monaural vs. binaural was left to the user. Of the 18 users choosing monaural amplification 6 had "no response" in 1 ear (but only 2 chose CROS aids), 2 had physical impairments preventing handling an aid

Table 1

Mean Pure-Tone Thresholds and Standard Deviations (SD) for the Less and More Severe Hearing-Impaired Groups

Group	Less		More	
Ear	R	L	R	L
Frequency				
250 Hz				
Mean	12	13	39	34
S.D.	9	9	23	17
500 Hz				
Mean	15	15	44	43
S.D.	9	9	20	18
1000 Hz				
Mean	21	22	51	52
S.D.	10	10	18	15
2000 Hz				
Mean	41	47	62	64
S.D.	17	17	21	19
3000 Hz				
Mean	60	65	75	78
S.D.	17	16	22	18
4000 Hz				
Mean	69	71	78	79
S.D.	13	15	22	18

Table 2

Mean (and Standard Deviation) Pure-Tone Averages (PTA), Speech Reception Thresholds (SRT), and Discrimination Scores (DS) for the Less and More Severe Hearing-Impaired Groups

Group		Less		More	
Measure		Mean	SD	Mean	SD
PTA	R	26 dB	12 dB	52 dB	20 dB
	L	28 dB	12 dB	53 dB	17 dB
SRT	R	19 dB	7 dB	48 dB	20 dB
	L	21 dB	8 dB	55 dB	18 dB
DS	R	88%	6%	64%	22%
	L	88%	8%	58%	22%

in 1 ear, and 10 simply did not want to wear 2 aids. Of the 98 aids issued from the VA contract aids, 66 were custom in-the-ear aids and 32 were

conventional aids (over-the-ear, body, etc.) (Table 4). Thirty-seven users wore custom aids (64%) and 21 users (36%) wore stock aids. Conventional aid users accounted for 27% of the binaural aids issued and custom aid users accounted for 73% of the binaural fittings.

Table 3

Number and Group Percentage (%) of Monaural and Binaural Hearing Aids Issued to the Less and More Severe Hearing-Impaired Groups and to the Total Number of Subjects

Group	Less		More		Total	
Subjects Aided	No.	%	No.	%	No.	%
Type of Fitting						
Monaural	10	26	8	40	18	31
Binaural	28	74	12	60	40	69

Table 4

Number and Percentage (%) of Custom and Conventional Aids Selected and Worn by the Veterans in the Less and More Severely Hearing-Impaired Groups

Group	Less		More		Total	
Subjects Aided	No.	%	No.	%	No.	%
Type of Fitting						
Custom ITE	51	77	15	47	66	68
Conventional	15	23	17	53	32	32

Psychological Measures

A 1-way (2 hearing impairment level) multivariate analysis of variance for 13 dependent variables was performed using the NYBMUL program. The 13 measures were: (1-7) the raw scores on each of the 7 subtests of the Wechsler Memory Scale; (8) the MMPI Pa scale score; (9) the Zung Self Rating Depression Scale (SRDS) raw score; (10-11) average raw score on the Denver and Profile Questionnaires (Alpiner, 1975; Sanders, 1975); (12-13) number of seconds taken to complete Part A and Part B on the Trail-making test. The scaled score for the Information subtest on the WAIS was used as a covariate for this analysis.

Results of the MANOVA indicated a significant effect of hearing impairment $F(13,44) = 2.4042$, $p < .015$. Since the main effect for hearing group was significant, the univariate F's could be examined. Table 5 lists the means for each of the groups for each of the scores included in the analysis together with univariate F values.

Table 5

Means for 13 Measures for the Less and More Severely Hearing-Impaired Groups for Time 1 and Time 2 Testing

Measure	Hearing Group				F Value for Time 1
	Less		More		
	Time 1	Time 2	Time 1	Time 2	
WMS - Pers. Info.	5.32	5.51	5.33	5.70	.00
WMS - Orientation	4.92	4.80	5.00	4.88	1.79
WMS - Mental Control	6.73	6.77	6.33	7.11	.48
WMS - Logical Memory	9.36	8.84	6.19	7.40	15.73[b]
WMS - Digit Span	10.11	10.70	9.71	9.78	.65
WMS - Vis. Reprod.	8.05	9.19	6.48	8.17	3.50
WMS - Pd. Assoc.	13.85	14.53	11.59	12.70	6.54[b]
MMPI Pa[a]	9.32	8.80	10.24	10.06	1.47
Zung SRDS[a]	33.62	34.87	36.67	34.05	1.45
Denver Scale	3.81	5.30	3.51	5.17	.69
Profile Questionnaire[a]	4.09	2.32	4.58	2.77	2.25
Trails A[a]	49.46	45.29	57.05	44.05	1.64
Trails B[a]	121.03	114.00	154.81	133.00	2.06

[a]Lower score means better performance.

[b]$p < .01$

As can be seen 2 univariate F's reached significance — the Wechsler Memory Scale subtest on Logical Memory (a test of memory of stories about 1 paragraph in length), $F(1,56) = 15.73$, $p < .0003$; and the Wechsler Memory Scale subtest on Paired Associate Learning, $F(1,56) = 6.54$, $p < .0133$. While the 11 other scores did not reach significance the differences in means tended to be in the direction of poorer performance by the more severely impaired group. The more severely hearing impaired individuals were less alert to information from the environment, less capable at remembering meaningful material and less capable at learning a new task, tended to be less capable at immediate auditory memory and visual spatial tasks as well as being less well oriented, were more paranoid and more depressed, and perceived themselves as experiencing more problems in coping with the environment due to their hearing loss. On only 2 group scores did the less severely impaired show poorer performance (WMS — Personal Information, a test of 6 questions assessing awareness of important persons in the environment and about oneself; WMS — Orientation, a test of 6 questions assessing orientation to time and place) than the more severely impaired group. It should be noted that the scores for the MMPI Pa scores are at normal levels of functioning according to the MMPI profile (Dahlstrom, Welsh, & Dahlstrom, 1972). In addition, the Zung SRDS

scores for both groups fall within normally functioning levels (Zung, 1965). Clinically then, interpretation of the MMPI and Zung scores would not lead to concern over psychopathological symptoms.

The 2 scores on the Trailmaking test are clinically significant. However, it must be noted that most of the subjects tested in this study were over age 45 and data on the Trailmaking test has indicated that subjects over age 45 tend to fall into the impaired range as part of a normal aging phenomenon (Davies, 1968; Reed & Reitan, 1963a, 1963b).

Since it was acknowledged that differences in health status may have accounted for the differences in the 2 hearing impaired groups, a post-hoc check on health status was made by itemizing the number of illnesses and disabilities experienced by a random sample of each of the 2 groups. These were categorized in various ways — total number of disabilities, current problems and chronic problems. There were essentially no differences between the 2 hearing level groups in any of these categorizations.

A 1-way (2 hearing groups) MANOVA was performed on scores for Time 2 residualized from Time 1 scores. The results of that analysis indicated that there was no significant difference between the groups in performance after the rehabilitation period of 6 weeks, $F(.00)$ $p < 1.00$. The means for each group for Time 2 may be seen in Table 5. The change from Time 1 toward similarity in the groups was achieved in some cases by a decline and in others by an improvement on performance so it does not appear that practice effects alone could account for the change. In the case of WMS Personal and Current Info., WMS Mental Control, WMS Digit Span, WMS Visual Reproduction, WMS Paired Associates, Trailmaking Test Part A and Part B there was an improvement in performance for both groups. In the case of WMS Orientation there was a decline in performance for both groups. For WMS Logical Memory, MMPI Paranoia and Zung there was a mixed picture in the change in scores for the 2 groups. The Denver Scale and the Profile Questionnaire both indicate subjects perceived improvement in ability to hear and get along in the environment. Generally, the improvement that occurred in the scores was far greater for the more severely impaired hearing group members.

DISCUSSION AND CONCLUSIONS

The finding of poorer psychological functioning in the more severely hearing impaired group indicates a deterioration in psychological functioning as a function of hearing impairment. The 2 scales on self-perceived adjustment to hearing impairment in interpersonal and physical environment (the Denver Scale and Profile Questionnaire) indicate that the subjects felt that other people react impatiently with the respondent, that more effort must be made to gain information from the environment, and that many stimuli are missed in the environment. Also indicated is that the decline in

psychological functioning can be reversed to some extent. These results seem to indicate the need to diagnose and remedy the situation with hearing aids as soon as possible to keep greater unaided decline from occurring.

There are a number of research questions suggested by these results. First, what is the process that produces the negative adjustments in response to hearing loss? For example, to what extent does perceived negative feedback from the environment contribute to the development of depressions, paranoia, and memory loss? The attitudes and perceptions of the significant others in the hearing impaired individuals' environment would be especially important here. Is the length of time that the environmental stimuli are reduced a more powerful force than the actual impairment in producing negative psychological effects? What psychological deficits are produced by lack of stimulation? Do hearing impaired 50 and 60 year old veterans differ significantly on psychological tests from their age matched non-impaired peers? To what extent does a relationship between hearing impairment and hearing handicap exist in the late middle aged population? Other questions concern change in the functioning of the hearing impaired after acquiring hearing aids. Why didn't the 2 groups show equal improvement in functioning after amplification? Does the improvement in functioning hold over time (6 months or 1 year)? Does the greater contact with the environment that is produced by hearing amplification account for the generally improved mental state?

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