Some Factors Affecting Assessment of Hearing Handicap in the Elderly

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Abstract
In 42 elderly hearing-impaired persons we compared the patient's self-assessment of hearing handicap with the assessment made by the patient's significant other. In general, patients tended to rate themselves as less handicapped than did their significant others. The difference was not affected by degree of loss but was affected by slope of loss and by the presence of central auditory processing deficit. Results support the value of the handicap assessment by the significant other in understanding the communication problems of the elderly patient.

Key Words: Hearing handicap, Hearing Handicap Inventory for the Elderly (HHIE), presbyacusis, significant other

In view of the important role of self-assessed handicap in understanding the communication difficulties encountered by elderly persons (Schow and Nerbonne, 1982; Ventry and Weinstein, 1982; Weinstein and Ventry, 1983; Newman and Weinstein, 1988), it is of interest to examine the influence of variables assumed to be relevant to such assessments. Among these are audiometric variables like degree of loss, slope of loss, problems in speech understanding and central auditory processing disorders as well as extra-auditory variables, especially cognitive deficits. Another dimension of the self-assessment problem is the extent to which the patient's judgment of handicap agrees with the judgment of a person with whom the patient interacts in daily living (e.g., the spouse or significant other [SO]).

The extent to which audiometric variables like degree of loss, slope or contour of loss, problems in speech understanding, and disorders of central processing, etc. influence the self-assessed handicap score have been studied extensively (Berkowitz and Hochberg, 1971; Noble, 1978; Giolas, 1982). Investigators have examined the effects of both degree of threshold hearing loss and supra-threshold speech understanding scores (High et al, 1964; Speaks et al, 1970; McCartney et al, 1976; Weinstein and Ventry, 1983; Lutman et al, 1987; Matthews et al, 1990). In general, investigators have observed only modest correlations ($r = 0.3$ to $0.7$) between handicap scores and indices of either absolute pure-tone sensitivity loss or slope of loss, and relatively weak correlations ($r = -0.1$ to $-0.4$) between handicap scores and measures of speech understanding.

The impact of central auditory processing disorder (CAPD) on self-assessment of hearing handicap has also been explored (Jerger et al, 1990; Fire et al, 1991). These studies have shown that persons whose speech audiometric profiles suggest CAPD report more hearing handicap than non-CAPD subjects with the same degree of hearing sensitivity loss. Thus, both peripheral and central auditory factors affect an individual's self perception of hearing handicap.

Optimal understanding of the nature of a person's hearing problem and the benefits or limitations one might anticipate from intervention requires an appreciation not only of how that person perceives his or her problem but also of how others in that person's immediate environment perceive the problem. Thus, both Newman and Weinstein (1988) and Schow and Nerbonne (1982) have suggested that, ideally, one should compare the patient's perception of
handicap with a similar judgment made by a significant other (i.e., the patient's spouse, companion, friend, etc.). Few studies, however, have made such comparisons. It is not clear, therefore, how either peripheral auditory, central auditory, or extra-auditory factors contribute to a significant other's assessment of hearing handicap or the extent to which the patient's estimate of handicap agrees with the estimate made by the significant other.

The purpose of the present study is to compare, in a sample of the elderly population, the handicap as assessed by the elderly patient with the handicap assessed by his or her significant other, and to examine the extent to which such comparison is affected by auditory and extra-auditory factors.

**METHOD**

**Questionnaire**

The Hearing Handicap Inventory for the Elderly (HHIE) (Ventry and Weinstein, 1982) was administered to all subjects. In addition, a modification of the HHIE, the HHIE-SO, was administered to the patients' significant others. Throughout the remainder of this paper, the handicap as judged by the patient is designated the self-reported handicap (SRH). The handicap as reported by the significant other is designated the significant other handicap (SOH). Thus SRH refers to the handicap score reported by the patient, while SOH refers to the handicap score provided by that same patient's SO.

**Subjects**

Subjects were 42 elderly individuals and their significant others. In most cases (74%), the significant other (SO) was the spouse of the hearing-impaired patient. If there was no spouse, the patient identified someone who frequently interacted with him/her as a communication partner to fill out the questionnaire.

In the study patient group there were 30 males and 12 females ranging in age from 60 to 83 years. The mean age was 70.4 years. Subjects were all paid volunteers participating in a larger study exploring the impact of hearing aids on the quality of life of elderly individuals with hearing impairment. None of the subjects had previously worn, or were now wearing, a hearing aid/s. All were ambulatory and in good general health.

In the SO group there were 5 males and 37 females, ranging in age from 46 to 81 years. Thirty-one SOs were spouses of study patients, 4 were friends, 6 were sons/daughters or sons-in-law/daughters-in-law, and one was a sister. Only one of the SOs was a hearing aid user. The aid had been worn for 5 years. The average duration of acquaintance of the patient and his/her SO, based on interviews with 34 SOs, was 40.4 years, and ranged from 6 months to 65 years.

**Procedure**

Questionnaires were administered in a paper and pencil format. For the SRH the administration was always in the presence of the tester. In the case of the SOH the administration was sometimes carried out in the presence of the tester and sometimes carried out by the significant other off site. The scoring system results in a possible outcome between 0 and 100 percent, where 0 percent indicates no handicap and 100 percent indicates maximum handicap. Weinstein and Ventry (1983) have reported that a score of 17 percent or more denotes significant handicap.

Conventional air conduction pure-tone audiograms were obtained on each ear of all subjects at test frequencies of 250, 500, 1000, 2000, 3000, 4000, and 8000 Hz. Conventional immittance audiometry was then carried out to evaluate middle ear status. Tympanograms were measured at a probe-tone frequency of 220 Hz. Acoustic reflex thresholds were then measured (in the crossed mode at 500, 1000, 2000, and 4000 Hz; in the uncrossed mode at 1000 and 2000 Hz). In none of the 42 subjects was there any evidence of middle ear abnormality. It was assumed, therefore, that the peripheral component of the hearing disorder was sensorineural.

Central auditory processing and/or cognitive deficits were evaluated by means of the Dichotic Sentence Identification (DSI) test (Fifer et al., 1983). In this test, pairs of synthetic sentences, adapted from the Synthetic Sentence Identification (SSI) test, are presented simultaneously to the two ears. In the present study the presentation level at each ear was an intensity level based on the average of the hearing threshold levels at 500, 1000, and 2000 Hz (PTA) of the poorer ear. The presentation level was always at a sensation level of 20 dB relative to the poorer ear PTA. This same physical intensity was also the presentation level to the better ear. Thus, if the PTA, was 30 dB on
the better ear and 40 dB on the poorer ear, then the presentation level was 60 dB HTL on both ears. The purpose of this procedure was to ensure adequate audibility of the DSI sentences on the poorer ear while preserving equal physical intensities of the two target sentences as a feature of the test.

In the present study there were two experimental DSI conditions; divided attention (DA) and focused attention (FA). In the DA task the subject scanned a list of 10 synthetic sentences and reported the two numbers corresponding to the two sentences heard. Percent correct scores were obtained for each ear. In the FA task the subject heard the two SSI sentences presented simultaneously, but reported only one sentence. Prior to the presentation of a block of sentences, the subject was pre-cued to report only the sentence heard in the pre-cued ear while ignoring the sentence heard in the opposite ear. For both the DA and FA conditions a total of 20 sentences was presented, 10 with the right ear as the pre-cued target ear and 10 with the left ear as target. Percent correct scores were calculated separately for each ear.

All audiometric testing was performed with a Virtual Audiometer, Model 320, and an Amplaid, Model 720 Immittance instrument. Speech understanding tests were presented via magnetic tape recordings. Test signals were routed to standard TDH-50 earphones mounted in conventional circumaural cushions.

**SCORING**

**Categorization by Degree of Loss**

To compare SRH and SOH scores as a function of degree of high-frequency hearing loss, subjects were categorized into four groups on the basis of the average of the hearing threshold levels at 1000, 2000, and 4000 Hz (PTA<sub>1000</sub>) of the better ear. The mean PTA<sub>1000</sub> of the total group was 40.14 dB HL with a range from 18 to 62 dB. Subjects in group 1 had PTA<sub>1000</sub> scores ranging from 18 to 30 dB HL. Subjects in groups 2, 3, and 4 had scores ranging from 31 to 40 dB HL, 41 to 50 dB HL, and 51 to 62 dB HL, respectively. There were 9 subjects in group 1 (5 females, 4 males), 15 in group 2 (2 females, 13 males), 11 in group 3 (5 females, 6 males), and 7 in group 4 (all males).

**Categorization by Audiometric Slope**

To analyze the effect of slope of hearing loss on SRH and SOH scores, subjects were divided into three slope groups, characterized as Gradual, Steep, and Very Steep. Slope was defined as the difference between threshold HTLs at 1000 Hz and 4000 Hz in the better-hearing ear. Subjects in the Gradual group had difference scores ranging from 0 to 20 dB. Subjects in the Steep Slope group had differences ranging from 25 to 35 dB, while for subjects in the Very Steep Slope group differences ranged from 40 to 60 dB. Eight subjects (6 females, 2 males) were categorized as having a gradual slope, 14 subjects (4 females, 10 males) as having a steep slope, and 20 subjects (2 females, 18 males) were placed in the Very Steep Slope group.

**Categorization by Cognitive and Central Auditory Status**

Status on these two variables was defined by the outcome of the DSI test. DSI test scoring was based on the criteria set forth by Fifer et al (1983). The DSI test was considered abnormal (but not necessarily consistent with central auditory disorder) if the difference between left and right ear scores exceeded 16 percent, provided that the PTA1 was less than 40 dB HL in both ears. If the PTA1 was greater than 40 dB HL, then the criterion of abnormality was an ear difference greater than 37 percent. DSI scores were also considered abnormal if the absolute ear score on either ear fell below the criterion of abnormality specified in Figure 3 of Fifer et al., 1983. Only subjects with abnormal results in both conditions (DA and FA) were categorized as having DSI results consistent with central auditory processing disorder. Subjects who were scored as abnormal in the DA condition but within normal limits in the FA condition were presumed to have cognitive rather than specifically central auditory deficits. This categorization was based on the following considerations:

1. There is no physical difference between the stimuli employed in the DA and FA conditions. The difference is instructional only. In the DA condition the subject is instructed to report what was heard in both ears. In the FA condition, however, the subject is instructed to report only what was heard in the pre-cued ear. This difference in instructions, between DA and FA, is presumed to change the cognitive demand of the task, but to have relatively little effect on a performance deficit resulting from a central auditory processing disorder.
2. A unilateral deficit in the DA condition, coupled with normal performance in the FA condition, cannot be explained as a purely auditory factor since it was eliminated by altered instructions in the FA mode. We assume, therefore, that the deficit in the DA condition had a largely cognitive basis.

3. A unilateral deficit in both the DA and FA conditions must have a largely central auditory basis. Changing the cognitive demand by changing instructions did not influence the effect.

Finally, there were no subjects in our sample who performed normally in the DA condition but abnormally in the FA condition.

**Statistical Analysis**

Because of the presumed statistical dependence between the handicap estimate made by the patient (SRH) and the estimate provided by the significant other (SOH), we elected to treat the two estimates as paired, correlated data. Thus when comparing the means of respondent groups on a single factor or variable, we elected to employ the paired t-test. Similarly, when the two groups are compared across more than one factor or variable, as in the analysis of variance, we elected to treat the respondent dimension as a within-subject, rather than a between-subjects, factor.

For the evaluation of statistical significance we elected an alpha level of 0.05.

**RESULTS**

Overall, our results reflect a significant discrepancy between the handicap as self-reported by the patient and the handicap as reported by the significant other. Table 1 summarizes the distributions of total HHIE scores and the distributions of the Emotional and Social/Situational subscores. In general, patients reported significantly less hearing handicap than did their SOs. The average total HHIE score was 27.19 percent for SRH, but 33.05 percent for SOH ($t = 2.33, p = 0.02$). Table 1 also compares handicap estimates based on the Emotional and Social/Situational subscores of the HHIE. There was little difference between results on the two subscales. The average difference between SRH and SOH was 3.15 percent for the Emotional scale and 2.52 percent for the Social/Situational scale. Both differences were statistically significant (emotional, $t = 2.00, p = .05$; social/situational, $t = 2.19, p = 0.03$).

**Distribution of Differences between SRH and SOH**

Surprisingly, there was considerable variation in the difference between the HHIE scores of the patient and his/her significant other. Figure 1 shows a histogram of the difference scores of the 42 subjects. Differences ranged from a high of 38 percent (SOH greater than SRH) to a low of 24 percent (SRH greater than SOH).

**Effect of Degree of Hearing Loss**

Is the discrepancy between the SRH and SOH handicap scores affected by degree of hearing loss? Figure 2 shows average handicap scores, for both SRH and SOH, as a function of high-frequency hearing sensitivity (PTA2) of the better ear. Not unexpectedly, the amount of handi-

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Effect of Audiometric Slope

Can the discrepancy between SRH and SOH scores be explained by differences in audiometric contour? Is the SOH score more likely to agree with the SRH for some shapes of loss than for others? To address this question we divided the total group of elderly persons into three subgroups according to the slope of the audiometric contour. Figure 3 shows the average audiogram of the better ear of three subgroups categorized according to the difference between threshold HTLs at 4000 Hz and at 1000 Hz.

Average SRH and SOH handicap scores are shown in Figure 4 for each of these three slope groups. In the Gradual group the mean SRH was actually slightly greater than the mean SOH, but the mean difference was not significant (t = 0.71, p = 0.50). In contrast, in the Steep and Very Steep groups the mean SRH was less than the mean SOH. For the Steep group the difference approached significance (t = 1.96, p = 0.07) and in the Very Steep group reached the significance criterion (t = 2.05, p = 0.05). Apparently patients and their SOs are in better agreement on the degree of handicap when the slope of the audiogram is gradual than when the slope is steep or very steep.

Since steeply sloping audiograms are more common in males than in females, it is relevant to ask whether the slope effect illustrated in Figure 4 is, in fact, a gender, rather than a slope, effect. To address this question we compared handicap scores for males and females in the Steep group only. There were ten males and four females. Figure 5 compares SRH and SOH scores for the two genders when audiometric slope is held constant. We observe that, on the average,
the SOs of both the male and female patients reported more handicap than their patient counterparts. Overall, males and their SOs reported slightly more handicap than did females and their SOs, but the difference was not significant. A two-factor, repeated measures ANOVA revealed no significant differences for the main effect of gender (F = 0.37, p = 0.56) or the interaction between gender and hearing handicap (F = 0.04, p = 0.85). Thus, gender does not appear to account for the slope effect illustrated in Figure 4.

Effects of Cognitive and Central Auditory Deficits

Can the discrepancy between SRH and SOH scores be explained by the presence of cognitive or central auditory deficits in some elderly persons? Is it possible, for example, that the SOs of patients with central auditory problems are more aware of the handicapping effects of the auditory problem than the patients themselves? Is a similar effect observed in elderly persons whose DSI scores reflect more cognitive than auditory problems? To address these questions we categorized subjects as normal, cognitive, or central auditory, according to the results of the Dichotic Sentence Identification test, then compared the mean SRH and SOH scores. To ensure that the comparison was not contaminated by slope of loss it was necessary to match the three groups in terms of audiometric contour and level. This was accomplished by selectively discarding subjects until the average audiograms were satisfactorily matched. In this fashion 11 subjects were placed in the “DSI normal” group, 12 in the “DSI cognitive” group, and 12 subjects in the “DSI central auditory” group. Figure 6 shows the average audiograms of the better ears of these three DSI groups. The purpose of this matching was to ensure that differences among the three groups on the HHIE scores were not the result of differences in audiometric shape or degree of loss. We also noted that chronologic age was not widely discrepant in the three groups. Average ages were 69.9 in the normal
Figure 7 Comparison of HHIE handicap scores as assessed by both patients (SRH) and by their significant others (SOH), in 35 elderly subjects categorized as either normal, cognitive, or central auditory according to DSI test results.

Mean handicap scores for each DSI category are shown as a function of respondent group in Figure 7. In all three groups, the mean SOH was greater than the mean SRH. In the case of the normal and cognitive groups, however, the difference was not statistically significant (DSI normal group, $t = 1.14, p = 0.28$; DSI cognitive group, $t = 0.77, p = 0.46$). In the DSI central auditory group, however, the difference in average HHIE scores exceeded 10 percent and was significant ($t = 2.24; p = 0.046$). Thus we observed a significant discrepancy between SRH and SOH scores only in the DSI central auditory group (i.e., in patients with presumed central auditory deficit).

Is this central auditory effect sufficient to explain the slope effect illustrated in Figure 4. Is it possible, for example, that the significant difference between SRH and SOH scores in the Very Steep group results from a disproportionate representation of DSI central auditory patients? To address this question we repeated the audiometric slope analysis, but confined the comparisons to patients not included in the “DSI central auditory” category. Figure 8 shows handicap scores as a function of slope, but only for patients in the DSI normal and DSI cognitive groups. The pattern of results was similar to that shown in Figure 4. Thus the audiometric slope effect appears to be independent of the central auditory effect.

DISCUSSION

The present results suggest that elderly persons tend to rate their hearing handicap less severely than do their significant others. In contrast to these results Newman and Weinstein (1986) found that patients reported more handicap than did their spouses. However, all of their elderly subjects were male veterans, who may have had an incentive to exaggerate the degree of handicap. This interpretation is supported by the data of Figure 9, which also shows the results of Weinstein and Ventry (1983) based on 100 elderly persons, both male and female, drawn from three different metropolitan speech and hearing centers. These data show a reasonably linear relation...
between better-ear PTA, and total HHIE score. Also plotted in Figure 9 are the results of Newman and Weinstein (1986), based on 30 male veterans. Note that their SRH results are well above the trend line representing the Weinstein and Ventry (1983) data. Plotted in Figure 9 as well are the present results. The present SRH data are in closer agreement with the original Weinstein and Ventry norm. Note also that the present SOH result add the Newman and Weinstein SOH result define a line running roughly parallel to, and slightly above, the Weinstein and Ventry norm. It seems likely, therefore, that the discrepancy between our present results, showing greater SOH than SRH, and the findings of Newman and Weinstein, showing greater SRH than SOH, can best be explained by assuming that the Newman and Weinstein result is unique to the special subject sample they employed.

The present results suggest, further, that both peripheral and central factors influence self-assessed perception of hearing handicap. Degree of loss appears to have the same effect on both patients and their SOs, but slope of loss seems to have more effect on the SO than on the patient. One might speculate that this effect reflects a fundamental difference in the basis for assessing handicap. Suppose, for example, that patients assess handicap based on "best hearing" (i.e., that portion of the audiogram where sensitivity is least impaired). Suppose, on the other hand, that SOs base their assessment of handicap less on overall sensitivity loss than on frequency of misperceptions. Then a person in the present Very Steep slope group, who has relatively little sensitivity loss over the range below 1000 Hz, and is not always aware that he misperceived a word beginning or ending with a high-frequency consonant, might not sense as much handicap as the spouse who is more acutely aware of the frustration and irritation brought on by these misperceptions. In this connection it is interesting to review the data illustrated in Figures 3 and 4. The patients in these three subgroups assessed their handicaps in proportion to loss below 2000 Hz. The SRH score was slightly larger for the Gradual group than for the Steep and Very Steep groups. SOs, however, showed average SOH scores more closely related to degree of loss above 1000 Hz. In other words, the speech perception deficit attributable to the loss of high-frequency information is, perhaps, less devastating to the patient than to the persons around him since the patient has relatively good sensitivity in the low-frequency range and is less aware of the problems in interpersonal communication resulting from poorly perceived high-frequency consonant sounds than are those with whom he or she must communicate in daily living.

The presence of central auditory deficit, as quantified by performance on the DSI test, also affected SRH and SOH scores differently. Patients with a dichotic deficit in both divided and focused attention conditions reported more handicap than patients without such dichotic deficits. Additionally, the patients themselves reported less handicap than did their SOs. In contrast, patients without dichotic deficits, or with deficits assumed to be primarily cognitive, rated handicap similarly. Thus, the SOs appeared to be more aware of the handicapping effects of central auditory processing deficits than the patients themselves. Again, it may be that, in the case of patients with central auditory problems, the patients' report of hearing handicap is more related to degree of peripheral hearing sensitivity loss, whereas the patient's SO may be more sensitive to the difficulties in ordinary speech understanding resulting from the central problem. Thus the patient reports little handicap so long as hearing loss is not severe. The spouse, on the other hand, may be more acutely aware of the problems in everyday living resulting from the mistaken perceptions of the elderly person. This hypothesis is supported by the fact that previous studies of HHIE, as reported by the patient, have shown better correlations between degree of hearing loss and self-reported handicap, than between speech
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recognition scores and self-reported handicap (Giolas, 1982; Weinstein and Ventry, 1983).

Clinicians frequently encounter patients whose motivation to seek help is that “my spouse thinks I have a hearing problem.” The present results suggest that either a steeply sloping high-frequency peripheral hearing loss or a central auditory processing deficit may be a pivotal factor in such a report. The fact that such patients may require alternative intervention strategies and considerable counseling to help them understand the nature of their hearing problems is now widely accepted. The use of the handicap assessment by the SO may help to identify such problems.

Four possible limitations of the present study should be explicitly stated. First, we did not obtain audiograms or other tests of auditory function from the SOs. It is possible that the presence of significant peripheral or central hearing disorder among these respondents may have affected the present results. This is certainly a possibility worth further study.

Second, the study patients represent only a narrow range of relatively mild losses in the mid-frequency range. Although all study patients were interested in the possibility of hearing aid use, none had previously worn an aid for any significant period of time. It may be that results would have been different for study subjects with greater degrees of loss who were previous hearing aid users.

Third, the average differences between SRH and SOH scores were not large, on the order of about 10 percent in the steep and central auditory groups. Differences of such magnitude are certainly not consistent with dramatic discrepancies between the perceived handicaps of the patient and the significant other. The average score, however, fails to reflect the relatively large discrepancies present in individual pairs. As noted in Figure 1, individual difference scores ranged from 38 percent (SO rating higher than SRH) to -24 percent (SRH rating higher than SO rating). Further study of these effects should perhaps focus on factors related to individual differences in discrepancy scores.

Fourth, the central auditory and cognitive effects were defined only by a single dichotic test (DSI). Further study of SRH versus SOH handicap scores should, perhaps, include more comprehensive evaluations of these two aspects of handicap in the elderly.

Acknowledgment. Supported, in part, by research grant AG-08958 from the National Institute on Aging. Eric Florin assisted in data acquisition.

REFERENCES


