Responses of Elderly Hearing Aid Users on the Hearing Aid Performance Inventory

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Abstract
The responses of hearing aid users aged 65 to 80 years to a 64-item measure of perceived benefit afforded by hearing aids were collected in order to develop normative data concerning the perceived benefit afforded specifically to elderly patients. Across most of the listening situations evaluated, the elderly respondents reported less perceived benefit than the generally younger listeners from the original normative study for this measure. For the current respondents, perceived hearing aid benefit was not related to variables such as average hearing loss, hearing aid style, or length of hearing aid use, but was related to hours per week of hearing aid use. A shortened version of this questionnaire is proposed, which uses just those questions most likely to be answered by elderly respondents.

Key Words: Hearing aids, elderly, questionnaire

Over the past several years, there has been increasing interest in developing new measures of the benefit provided by amplification. The traditional approach of comparing word recognition performance with and without hearing aids has fallen into disfavor, principally due to poor reliability and validity (Walden et al, 1983). As an alternative to word recognition testing, there have been several attempts to quantify hearing aid benefit through the use of self-report techniques (Birk-Nielsen and Ewertsen, 1974; Brooks, 1979; Tannahill, 1979; Dempsey, 1986; Newman and Weinstein, 1988; Malinoff and Weinstein, 1989; Cox and Gilmore, 1990). One recent effort by Walden et al (1984) led to the development of the Hearing Aid Performance Inventory (HAPI), a 64-item questionnaire designed to assess the benefit provided by amplification in a variety of listening situations. Walden et al (1984) report the HAPI to be internally reliable and apparently valid.

Currently, most hearing aids are used by elderly patients (Cranmer, 1988). Therefore, any behavioral measure of hearing aid performance should be appropriate for and standardized for this population. In the original study by Walden et al (1984), 128 subjects were drawn from an age range of 19 to 87 years with a mean age of 61 years (standard deviation = 14 years). Walden and his colleagues provided no information as to the relation between HAPI ratings and age. If the HAPI is to be used with elderly hearing aid users, it would be helpful to have normative information that is age specific.

There are several reasons to suspect that perceived hearing aid benefit may be lower in elderly users than in younger users. For example, the presence of central auditory processing or general cognitive difficulties may be more frequent in the elderly population (Hayes, 1985; Kausler, 1988). These limitations on the processing of information may restrict communication performance even with the increase in audibility provided by amplification. Further, other nonauditory factors such as manual dexterity, financial concerns, or limited social contacts may be expected to reduce the perceived benefit of hearing aids for some users. Personal reactions to the presence of amplification are multifaceted and poorly understood. The elderly seem to be prone to more potentially confounding influences.

Newman and Weinstein (1988) argue that there are limitations to the use of the HAPI with elderly listeners. First, they indicate that a 64-item questionnaire may be too long for many
elderly respondents. They contrast the HAPI to the Hearing Handicap Inventory for the Elderly (HHIE) (Ventry and Weinstein, 1982), which is only 25 items long. Secondly, Newman and Weinstein (1988) argue that many items on the HAPI describe situations that elderly hearing aid users do not often experience. For example, many of the items on the HAPI refer to occupational situations, which would be irrelevant to retired individuals.

In this project, two experiments have been carried out in order to examine in more detail the responses of elderly hearing aid users on the HAPI. In the first experiment, the results on the HAPI for 75 elderly respondents were reviewed in order to compare mean performance for an elderly-only sample to that of the original normative sample from Walden et al (1984), which was drawn from an age range of 19 to 87 years. The HAPI results from the current sample were then submitted to a multivariate analysis in order to examine potential relations between self-perceived hearing aid benefit and more easily measured audiometric and demographic variables. In the second experiment, a question by question analysis was carried out in order to arrive at a subset of the original 64 questions that are most likely relevant for elderly respondents.

**EXPERIMENT 1**

**Method**

**Subjects**

Patient records were reviewed from two audiology facilities, a medical school speech and hearing department, and a medium size private audiology practice to identify individuals who had been fitted with amplification during the previous 3 years. Many of the patients had been wearing amplification for more than 3 years, but had received a new hearing aid(s) during the previous 3 years. The 3-year time limit was imposed to limit the number of audiologists who had fitted the hearing aids and to insure that the respondents were using "current generation" amplification. The patients were fitted by one of four audiologists at the medical school or one of two audiologists at the private practice. The patients were required to fall into the age range of 65 to 80 years and were required to present a sensorineural type hearing loss. Eighty-two patients were identified as potential subjects through the medical school and 76 patients were identified through the private practice.

**Questionnaire**

The 64-item HAPI was used as the measure of perceived hearing aid benefit. The items on the HAPI attempt to assess the benefit provided by hearing aids in a variety of communication situations; for example, “You are at home in face to face conversation with one member of your family” (question 24), or “You are in a noisy office talking with a stranger on the telephone” (question 38). The subject is asked to rate the benefit provided by hearing aid(s) on a scale from 1 to 5, with 1 being “very helpful,” 2 being “helpful,” 3 being “very little help,” 4 being “no help,” and 5 being “hinders performance.” The subject also has the option to respond “does not apply.” The HAPI yields a grand mean rating and also mean ratings on four different factors: listening to speech in noise (factor 1), listening to speech in quiet (factor 2), listening to speech without the benefit of visual or other supplementary cues (factor 3), and listening to nonspeech or nonlive speech signals (factor 4). These four factors were identified by Walden et al (1984) via multivariate analysis of the responses of the original 128 subjects. Each of the 64 items load on either one or (in 15 cases) two different factors.

**Procedure**

A copy of the HAPI along with a set of instructions, a cover letter explaining the project, and a return mailing envelope were sent to each of the 158 identified potential subjects. They were also asked to confirm whether they were monaural or binaural users, the typical number of hours per week that they used amplification, and how long they had been using amplification. The subjects were informed that their results would be used both as part of the experimental database and also by their individual audiologist as part of follow-up clinical service. Out of respect for a patient’s decision not to participate, no follow-up procedures were carried out for subjects who did not return the questionnaire.

**Results**

Of the 158 questionnaires sent out, 75 (47.5%) were returned. Table 1 provides descriptive information as to the age, clinic, hear-
Table 1 Audiometric and Demographic Data for Respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>71.7 years (4 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD)</td>
<td></td>
</tr>
<tr>
<td>Clinic</td>
<td></td>
</tr>
<tr>
<td>Medical school</td>
<td>52%</td>
</tr>
<tr>
<td>Private practice</td>
<td>48%</td>
</tr>
<tr>
<td>Hearing aid style</td>
<td></td>
</tr>
<tr>
<td>BTE</td>
<td>17%</td>
</tr>
<tr>
<td>ITE</td>
<td>59%</td>
</tr>
<tr>
<td>ITC</td>
<td>24%</td>
</tr>
<tr>
<td>Monaural vs. binaural</td>
<td></td>
</tr>
<tr>
<td>Monaural</td>
<td>45%</td>
</tr>
<tr>
<td>Binaural</td>
<td>55%</td>
</tr>
<tr>
<td>Mean hours per week of use</td>
<td>49.8 hours</td>
</tr>
<tr>
<td>Length of use</td>
<td></td>
</tr>
<tr>
<td>2-6 months</td>
<td>12%</td>
</tr>
<tr>
<td>6-24 months</td>
<td>53%</td>
</tr>
<tr>
<td>2-5 years</td>
<td>16%</td>
</tr>
<tr>
<td>&gt; 5 years</td>
<td>17%</td>
</tr>
</tbody>
</table>

The current elderly monaural versus binaural, hours per week of use, and length of use for the current respondents. Figure 1 provides the mean audiogram from the current respondents and from the subjects from Walden et al (1984).

Figure 2 provides the mean HAPI rating (±1 standard deviation) for the entire scale and for the four factors for the current elderly subjects and the original subjects of Walden et al (1984). As can be seen, for the overall rating and for each of the four factors, the current elderly respondents report less benefit from amplification than the Walden et al (1984) respondents. For both groups, the most benefit is reported in quiet listening situations (factor 2) and the least benefit is reported in noisy situations (factor 1). The magnitude of the standard deviations are similar between the current elderly respondents and the Walden et al (1984) respondents.

T-tests for independent samples were performed comparing the mean overall HAPI rating and the mean HAPI rating on factors 1 through 4 between the two groups. These tests revealed significant (p < .05) group mean differences for the overall HAPI rating and for the HAPI rating for factors 2 (speech in quiet), 3 (speech with reduced cues), and 4 (nonspeech/nonlive speech signals).

Internal consistency of the HAPI for the current subject group was examined using coefficient alpha (Crocker and Algina, 1986). Only the responses of subjects who responded to all 64 items (n = 34) were used in the calculations. The mean overall HAPI rating for these 34 respondents was 2.29, which is similar to the mean overall HAPI rating of the full set of 75 respondents of 2.30. Therefore, this subset of 34 subjects was considered representative of the overall group. Alpha was .97 for the overall HAPI and was .93, .94, .91, and .88 for factors 1 through 4, respectively. Walden et al (1984) report alphas of .96 for the overall scale and .95, .92, .92, and .84 for factors 1 through 4, respectively.

Given that the HAPI requires a certain amount of time to complete, it would be useful to be able to predict perceived hearing aid benefit from information that is typically collected from hearing-impaired patients as part of a routine clinical evaluation. Therefore, an
analysis of covariance (ANCOVA), using BMDP program 2V (Dixon et al, 1985), was performed comparing the HAPI rating with more easily and rapidly measured audiometric and demographic measures. This particular ANCOVA package uses a nonsequential treatment of unbalanced data sets, consistent with the recommendations of Kutner (1974) and Speed and Hocking (1976). Overall HAPI rating was entered as the dependent variable; audiologist, hearing aid style, monaural versus binaural use, and length of hearing aid use were entered as independent variables; and average hearing level, audiometric slope (mean dB per octave/change from .5 kHz to 4 kHz), and hours per week of use were entered as covariates. Average hearing level was calculated as the mean at .5, 1, 2, and 4 kHz for the aided ear for monaural users and averaged over both ears for binaural users.

The only variable to yield a significant (p < .05) relation to overall HAPI rating was hours per week of use. The simple correlation between hours per week of use and overall HAPI rating was .33. In other words, more benefit was perceived for those respondents who tended to wear their hearing aid(s) more often.

EXPERIMENT 2

In an attempt to respond to the concerns expressed by Newman and Weinstein (1988) of the length and appropriateness of the HAPI for elderly respondents, a shortened version of the HAPI was created.

Method

From the data from the original 75 elderly hearing aid users, the responses to each of the 64 items were reviewed in order to identify those questions that were responded to by at least 90 percent of the subjects.

Results

Thirty-eight items met the criterion of being responded to by at least 90 percent of the elderly subjects. Consistent with the concerns of Newman and Weinstein (1988), those items dropped from the HAPI typically, but not always, involved occupational listening situations (e.g., question 11, "You are in a large office with the usual noise in the background. A co-worker is telling you the latest gossip from close range in a soft voice.").

Principal-factor analysis was performed on the 38 items from the shortened version of the HAPI using Statview II (Feldman et al, 1988). Data were used from only those subjects who provided responses to at least 30 of the 38 items (n = 69). The results are presented in Table 2. Only factor loadings ≥ .35 are shown. In the left section of the Table are the factor loadings reported by Walden et al (1984). In the right section of the Table are the loadings from the first three factors isolated in the current analysis. These three factors are the only ones accounting for at least 10 percent of the variance.

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Walden et al (1984) Factor Number</th>
<th>Current Analysis Factor Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>59</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>.51</td>
<td>.55</td>
</tr>
<tr>
<td>3</td>
<td>.48</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>.59</td>
<td>.72</td>
</tr>
<tr>
<td>7</td>
<td>.70</td>
<td>.57</td>
</tr>
<tr>
<td>8</td>
<td>.60</td>
<td>.67</td>
</tr>
<tr>
<td>10</td>
<td>.62</td>
<td>.58</td>
</tr>
</tbody>
</table>
| 13              | .46                              | .53                           | .90
| 14              | .49                              |                               |
| 17              | .37                              | .44                           | .41
| 19              | .49                              |                               |
| 20              | .47                              | .54                           | .90
| 22              |                                 | .70                           |
| 23              | .65                              | .78                           |
| 24              | .74                              | .90                           |
| 25              | .40                              | .43                           |
| 26              | .59                              | .78                           |
| 27              | .40                              | .45                           | .74 | .36
| 28              | .60                              |                               | .83
| 30              |                                 | .61                           | .87
| 31              | .63                              |                               | .79
| 32              | .38                              | .52                           | .82
| 34              | .36                              | .56                           | .54
| 35              |                                 | .78                           | .71
| 37              | .51                              | .37                           | .42
| 40              | .58                              |                               | .49
| 41              | .46                              | .42                           | .35
| 42              | .68                              | .64                           | .71
| 43              |                                 | .65                           | .50
| 47              |                                 | .74                           | .46
| 49              | .74                              |                               | .46
| 52              | .76                              | .56                           | .59
| 53              | .69                              |                               | .46
| 55              | .55                              |                               | .86
| 57              | .80                              |                               | .70
| 59              |                                 |                               | .61

*Question numbers from the original HAPI included on the 38-item shortened version along with the loadings on factors 1 through 4 reported by Walden et al (1984) and with the loadings on factors 1 through 3 produced via the current factor analysis.
after varimax rotation (30%, 17%, and 16%, respectively) and are the only ones that are easily interpretable. Inspection of the factor structure from the original Walden et al (1984) study and from the current analysis suggests that the new factor 1 conforms with the original factor 2, the new factor 2 conforms with the original factor 3, and the new factor 3 conforms with the original factor 1. Thus, three common factors were isolated in both analyses: speech in noise, speech in quiet, and speech with reduced cues. No factor emerged from the current analysis to conform to the original factor 4 from Walden et al (1984) (nonspeech/nonlive speech signals). Given the similarity in factor structure from the current analysis and the original study and given the greater number of subjects used in the original study, the Walden et al (1984) factor structure is used in all analyses of the 38-item version below.

New means and standard deviations were calculated for an overall HAPI rating and ratings on factors 1 through 4 based on the reduced set of 38 items and are listed in Table 3. Also included in Table 3 are the coefficients alpha for the overall 38-item test and for each of the four factors.

If a clinician chooses to administer either the 64- or 38-item version of the HAPI to an elderly hearing aid user, it would be helpful to compare the resultant ratings to those of other elderly hearing aid users. Table 4 provides the 10th, 25th, 50th, 75th, and 90th percentiles for the overall mean HAPI rating and for the mean rating on each of the four factors for both the full, 64-item HAPI and for the 38-item version.

The distributions of overall HAPI ratings for both the 64- and 38-item versions were found to be not significantly different from the normal distribution in terms of either kurtosis or skewness. Therefore, these percentiles are based on the means and standard deviations. An elderly person’s rating on the HAPI can thus be compared to these percentiles to determine how much perceived benefit is attained in various listening situations compared to a cross-section of other elderly hearing aid users.

**DISCUSSION**

The results from the full 64-item HAPI indicate that the elderly-only sample used in the current investigation generally perceived less benefit from their hearing aids than did those subjects from the original normative sample of Walden et al (1984). This difference in perceived benefit was supported statistically for the overall HAPI rating and for the ratings on factors 2, 3, and 4. However, for the most difficult listening situations, those questions that loaded on factor 1 (speech in noise), there was a nonsignificant difference between the two samples. It is also important to note that although elderly hearing aid users perceive less benefit from their amplification, they still do describe themselves as receiving benefit. The mean overall HAPI rating of 2.30 falls between “helpful” (2) and “very little help” (3), with only four of the 75 subjects providing a mean HAPI rating greater than 3.0 (between “very little help” and “no help”). For factor 2, speech in quiet, their mean rating of 1.94 falls between “very helpful” (1) and “helpful” (2). Even the poorest factor rating, speech in noise, was 2.57, which falls approximately equidistant between “helpful” and “very little help.”

The value of using a self-report measure of hearing aid benefit is supported by the fact that all but one of the audiometric and demographic variables were nonsignificantly related to perceived hearing aid benefit. Further, the correlation between HAPI ratings and the only signifi-
stantly related variable, hours per week of use, was low (.33). Generalized statements such as "patients with more hearing loss or patients who obtain binaural hearing aids will perceive more benefit from amplification" can not be supported by the present study. It must be noted, however, that the subject group was not necessarily balanced on any of the variables submitted for ANCOVA analysis. Perhaps a more direct investigation into perceived benefit of amplification as a function of one of the predictor variables with the other variable being controlled may reveal differences.

The manipulation of the items on the HAPI in Experiment 2 served to address both of the concerns expressed by Newman and Weinstein (1988) by reducing the test by nearly one-half and by using only those questions answered by most elderly hearing aid users. Examination of the coefficients alpha for both the overall rating and for each of the four factor ratings in Table 3 reveals that the shortened version of the HAPI retained a high level of internal consistency despite the loss of 26 items. The shortened, 38-item version provides a vehicle by which the audiologist can obtain situation specific information from elderly hearing aid users in a relatively quick and efficient manner. Although the number of subjects (n = 69) was low compared to the number of items submitted to factor analysis (n = 38), three distinguishable factors were isolated and these factors corresponded with the first three isolated factors from Walden et al (1984). The similarity in the factor structure of the shortened version and the original 64-item version would suggest that the 38-item version can provide similar summary information as to perceived benefit in noisy, quiet, and reduced-cue situations.

Hutton (1983) collected data on hours per week of hearing aid users as a function of user experience, age, and employment status. He argues that, within the cells of the experience by age by employment matrix, the 25th percentile of hearing aid wear time should be viewed as the threshold of intervention. In other words, if a person is using amplification less often than 75 percent of other persons with similar relevant characteristics, the audiologist should intercede and attempt to isolate those factors responsible for the relatively infrequent use of amplification. The percentile information presented in Table 4 can be used in a similar manner. Those patients who report less benefit than, for example, 75 percent of other elderly hearing aid users (HAPI rating falls above the 75th percentile) may be specially targeted for intervention. Given the lack of relation between perceived hearing aid benefit and most audometric and demographic variables, the use of the HAPI or some other self-report measure in this manner may be the best way to isolate those patients most in need of aggressive postfitting hearing aid service.

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REFERENCES


