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Speech Recognition Ability in Noise and Its Relationship to Perceived Hearing Aid Benefit

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Abstract

Hearing-impaired listeners with similar hearing losses may differ widely in their ability to understand speech in noise. Such individual susceptibility to noise may explain why patients obtain varying degrees of benefit from hearing aids. The chief purpose of this study was to determine if adaptive measures of unaided speech recognition in noise were related to hearing aid benefit. Additionally, the relationship between perceived hearing handicap and benefit from amplification was explored. Before being fit with hearing aids, 47 new hearing aid users completed a self-assessment measure of hearing handicap Then, unaided speech recognition ability was measured in quiet and in noise. Three months later, subjects completed a hearing aid benefit questionnaire. A weak relationship was observed between perceived hearing handicap and hearing aid benefit. There were no significant relationships between speech-in-noise measures and hearing aid benefit, suggesting that speech recognition ability in noise is not a major determinant of the benefit derived from amplification.

Key Words: Hearing aid benefit, hearing aids, hearing handicap, noise, speech recognition

Abbreviations: CPHI = Communication Profile for the Hearing Impaired, HAPI = Hearing Aid Performance Inventory, HINT = Hearing in Noise Test, NAL-R = National Acoustic Laboratories-Revised procedure, S/N = signal-to-noise ratio, SRT = speech recognition threshold

No reliable method currently exists for predicting hearing aid benefit in everyday communication. Clinical measures that can reliably predict benefit would be helpful in determining hearing aid candidacy and would assist audiologists in counseling hearing aid users about realistic expectations regarding their use of amplification. Several clinical researchers have attempted to identify the factors that are predictive of hearing aid benefit (Cox and Rivera, 1992; Mulrow et al, 1992; Cox and Alexander, 1993; Gatehouse, 1994; Crowley and Nabelek, 1996; Cox et al, 1999; Humes, 1999; Schum, 1999). A number of audiologic and nonaudiologic predictor variables have been proposed; however, no single variable or combination of variables has emerged as even moderately accurate in predicting subsequent hearing aid benefit.

Several investigators have suggested that individual differences in susceptibility to noise interference may be a primary factor in explaining why hearing-impaired individuals obtain varying degrees of benefit from hearing aids (Plomp, 1978; Dirks et al, 1982; Crandell, 1991; Killion, 1997). Listeners with sensorineural hearing loss often require a more favorable signal-to-noise ratio (S/N) than do normal-hearing individuals to obtain the same level of speech understanding (Dubno et al, 1984; Rowland et al, 1985; Gelfand et al, 1988; Bronkhorst and Plomp, 1990). This is not due simply to reduced hearing sensitivity, as listeners with similar degrees and configurations of hearing loss may differ widely in their ability to understand speech in the presence of noise (Nabelek and Pickett, 1974; Crandell, 1991). Plomp (1978)

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proposed a model of hearing impairment that suggests that hearing loss for speech is composed of two factors: (1) an attenuation factor that reduces the overall level of both speech and noise and (2) a distortion factor that is comparable to a reduction in the S/N. According to this model, the speech perception difficulty resulting from the distortion factor cannot be overcome with simple amplification, which does not improve the S/N. It would follow that those patients who have more of this distortion may receive less benefit from amplification. The main purpose of this study, therefore, was to determine whether susceptibility to noise interference, or distortion, is related to perceived hearing aid benefit.

It was also of interest to explore the relationship between perceived hearing handicap and self-reported benefit obtained from the use of amplification. Although it seems reasonable to expect that an individual with many perceived communication problems would derive more subjective benefit from a hearing aid than would an individual who reports fewer unaided communication difficulties, the results of clinical studies of this question are inconsistent. Cox and Rivera (1992) found that self-assessed unaided speech communication ability was positively correlated with subsequent hearing aid benefit. Similarly, Mulrow et al (1992) observed that unaided hearing handicap was positively associated with subsequent improvement in handicap and satisfaction with amplification. In contrast, Gatehouse (1994) and Schum (1999) reported that prefitting reports of hearing difficulty were not useful in predicting postfitting reports of benefit. A secondary goal of this study, therefore, was to examine further the relationship between hearing handicap and hearing aid benefit in a group of new hearing aid users.

METHOD

Subjects

Sixty adults with bilateral sensorineural hearing loss were enrolled as subjects. Forty-nine of the 60 subjects (81.7%) completed and returned the hearing aid benefit questionnaire that was mailed to them. Two of the returned questionnaires were eliminated because they were incomplete. Therefore, the complete data for 47 subjects are discussed here. The mean age of these 47 subjects was 40.6 years (SD = 7.4) with a range of 23.8 to 56.6 years. Subjects were selected from the active duty patient population

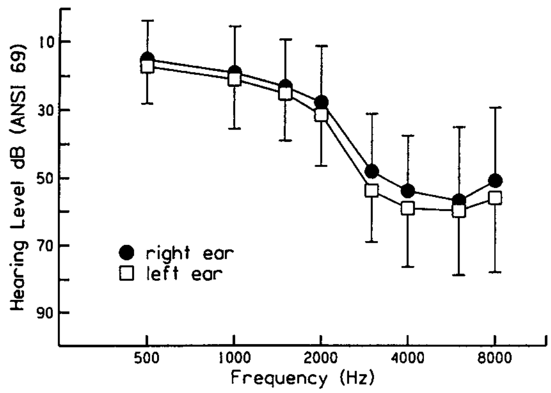

Figure 1 Mean audiometric data for the 47 subjects. The error bars for the mean data indicate one standard deviation.

of the Army Audiology and Speech Center. All were first-time hearing aid users and attended a 3½-day aural rehabilitation program after being fit with their hearing aids. All subjects were native speakers of American English. Two subjects were female, 45 were male. Case histories indicated that noise exposure was the likely cause of hearing loss for the vast majority of subjects. The mean audiogram for the 47 subjects is shown in Figure 1.

All hearing aids fit to the subjects in this study were custom, in-the-ear devices with Class D linear or Class D AGC-I circuitry. Hearing aids were fit to National Acoustic Laboratories-Revised (NAL-R) prescriptive targets. Forty-three of the subjects were fit binaurally and four were fit monaurally. The mean insertion gain, collapsed across right and left ears, for a total of 90 fittings, is shown in Figure 2. Also shown is the mean

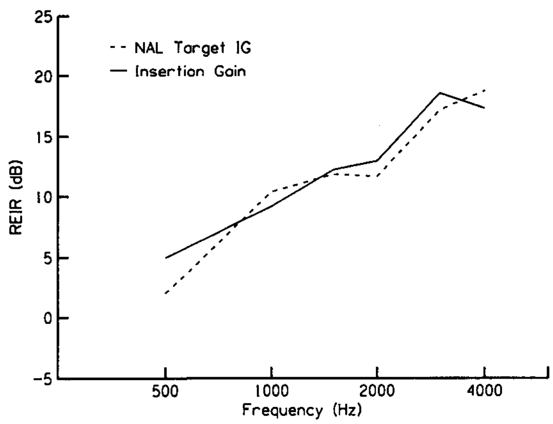

Figure 2 Mean insertion gain and mean NAL-R target gain for 90 hearing aid fittings for 47 subjects.

NAL-R target insertion gain (Byrne and Dillon, 1986) for these 90 fittings.

Self-Assessment of Hearing Handicap

Before being fit with hearing aids, subjects completed the Communication Profile for the Hearing Impaired (CPHI), a 145-item self-assessment inventory developed by Demorest and Erdman (1987). The CPHI yields 25 scale scores in six main content areas. In addition to items that assess communication performance, the CPHI provides an assessment of environmental factors that may affect communication, assesses communication strategies, evaluates the perceived importance of communication, and assesses personal adjustment to hearing loss. Also included are items designed to detect denial of handicap and awareness of problems. Each item of the CPHI is a statement (e.g., "I get aggravated when others don't speak up"). For some items, subjects indicate the extent of their agreement with the statement on a 5-point scale (1 = strongly disagree to 5 = strongly agree). For other items, subjects rate the frequency with which they feel the statement is true (1 = rarely or almost never, 5 = usually or almost always). For the communication importance items, the 5-point response scale ranges from not important (1) to very important (5). With the exception of the importance scale, items are scored such that lower scores indicate more problems.

Speech Recognition Testing

One way to quantify an individual's speech recognition difficulty in noise is by using an adaptive speech recognition technique as described by Plomp (1978). With this method, speech recognition is measured in terms of the S/N required for correct recognition of 50 percent of the speech stimuli. The 50 percent performance criterion, or speech recognition threshold (SRT), is found by systematically adjusting the level of the speech relative to the background noise. Traditionally, word lists have been used to measure speech recognition ability. Plomp and Mimpen (1979) advocated the use of sentence materials to measure SRT because sentences are more representative of everyday speech and have a steeper performance-intensity function than words. They developed phonetically balanced lists of equally intelligible Dutch sentences specifically for this use. Comparable English sentence lists have been created and recorded by investigators at the House Ear Institute (Nilsson et al, 1994).

Speaks et al (1972) described an alternative SRT procedure in which subjects used an attenuator to adjust the level of speech to a point at which they could just understand a specified percentage of continuous discourse in a fixed level of noise. Connected discourse stimuli have even greater face validity than sentences for assessing problems in everyday communication. Use of continuous discourse also eliminates the problems of phonemic balance and list equivalence inherent in the use of word or sentence lists. However, subjective judgments of speech intelligibility may provide results that are less reliable than procedures with objective verification of correct recognition performance (Walker and Byrne, 1985).

Although sentence and continuous discourse stimuli have greater face validity, the use of word stimuli may offer some unique advantages. Frequency-specific word lists may be more sensitive for the assessment of speech recognition difficulties encountered by patients with specific configurations of hearing loss (Van Tassel and Yanz, 1987).

In this study, we used adaptive procedures to obtain unaided SRTs for three types of stimuli: monosyllabic words, sentences, and continuous discourse. Three conditions were tested with each type of test material: (1) in quiet, (2) with a background noise level of 25 dB above the calculated quiet SRT, and (3) with a background noise level of 90 dB SPL. A moderate and a high noise level were chosen because there is some evidence to suggest that the SRT may be dependent upon the level of the noise (Walker and Byrne, 1985). Subjects were tested individually in a sound-treated room. Both the speech stimuli and the noise were presented binaurally via TDH 39 earphones. For the noise conditions, the background interference consisted of speech spectrum noise that matched the long-term spectrum of the stimuli. The speech and noise levels were independently adjustable. No correct answer feedback was provided to the subject. Speech recognition measures were completed in one test session.

Monosyllabic Words

The stimuli and procedures used to determine SRT for monosyllabic words were similar to those described by Van Tassel and Yanz (1987). Eight high-frequency monosyllabic words (hip, hit, hick, sip, sit, sick, ship, thick) were recorded by a male talker, digitized via a 12-bit analog-to-digital converter and laboratory computer, and stored on disk. The waveforms were edited to eliminate preceding and trailing noise and were equated for peak voltage. Data collection was carried out online. Subjects were seated facing a touch-sensitive computer screen displaying the eight monosyllables. After each stimulus was presented, the subject touched a word indicating a response choice. Stimulus selection and presentation were under computer control. Stimuli were sampled independently on each trial without duplication. The quiet SRT (i.e., level at which 50% of words could be correctly repeated) was established in the following manner. The first three stimuli were presented at a level above the subject's threshold. On the following trials, the stimulus level was increased after an incorrect response and decreased after a correct response. A step size of 4 dB was used until two reversals were obtained, then 1-dB steps were used for the remaining trials. A run was terminated after a total of 16 reversals. The SRT was calculated as the mean of the signal levels of the last 10 reversals. For the noise conditions, speech was initially presented at 10 dB above the noise level. The SRT procedure was the same as with the quiet condition. One practice run for each condition was administered before actual testing began. Then, each of the three conditions (one quiet and two noise) was repeated three times. The three S/N values obtained for each condition were averaged and reported as the SRT for that condition.

Sentences

Sentence stimuli consisted of the Hearing in Noise Test (HINT) (Nilsson et al, 1994) digitally recorded sentence lists. To establish the quiet SRT, the first sentence of a list was presented repeatedly (starting below the subject's threshold) with intensity increasing in 4-dB steps until the listener could reproduce the complete sentence correctly. The level was then decreased by 4 dB and the second sentence was presented. If the sentence was repeated correctly, the level was again decreased by 4 dB; if not, the level was increased 4 dB. This was repeated for all remaining sentences, using 4-dB steps for the first four sentences and 2-dB steps after that. Each sentence was presented only once, and subjects were instructed to repeat aloud what they heard. The level of the next sentence was based on the correctness of the response. The average level of the fifth to eleventh sentences was calculated as the SRT in quiet. For the noise conditions, speech was initially presented at 5 dB below the noise level. SRT in noise was established in the same manner as in quiet. One practice list for each condition was administered before actual testing began. Then, three lists were administered for each of the three conditions. The three S/N values obtained for each condition were averaged and reported as the SRT for that condition.

Continuous Discourse

An adaptive procedure using connected discourse was employed to obtain a subjective estimate of the S/N required for 50 percent speech intelligibility in quiet and in the two noise conditions. Speech stimuli consisted of a 20-minute digitally recorded book passage read by a male speaker with general American dialect. The subject adjusted the speech level in 1-dB steps by touching up or down arrows on a touch-sensitive computer screen. Subjects were instructed to adjust the speech to the point at which she or he could just understand 50 percent of what was being said. No time limit was imposed. After each trial, the speech attenuator was reset remotely by the experimenter to a level below the subject's threshold. One practice run for each condition was administered before testing began, then each of the three conditions (one quiet and two noise) was repeated five times for each subject. The five runs for each condition were averaged and reported as the SRT for that condition.

Assessment of Hearing Aid Benefit

Three months post hearing aid fitting, the Hearing Aid Performance Inventory (HAPI) (Walden et al, 1984) was mailed to each subject. The HAPI is a 64-item questionnaire that assesses hearing aid benefit in a variety of situations. Subjects rate each item on a 5-point response scale from 1 (very helpful) to 5 (hinders performance), indicating the degree to which they believe amplification helps in the situa-

Table 1 Mean Speech Recognition Thresholds (in SPL) Required for 50% Recognition of Each Stimulus Presented in Quiet

	Mean (SPL)	*SD*	*Range*
Monosyllables	37.2	9.3	19.9–56.8
Sentences	32.1	8.7	20.8–60.2
Discourse	38.2	9.1	24.4–63.6

Table 2 Mean Speech Recognition Threshold (S/N) Required for 50% Recognition of Each Stimulus Presented in Two Levels of Background Noise

	Mean (S/N)	*SD*	*Range*	*Mean SPL of Speech*
+25 dB SL noise				
Monosyllables	−6.8	3.1	−12.1–0.3	55.3
Sentences	−0.5	2.1	−4.0–6.0	56.5
Discourse	2.4	2.5	−1.0–11.8	65.5
90 dB SPL noise				
Monosyllables	−4.4	4.7	−10.8–7.6	85.6
Sentences	0.7	2.8	−2.6–9.7	90.7
Discourse	2.0	2.1	−3.0–7.8	92.0

tion described. Thus, a lower score indicates greater perceived benefit. The HAPI provides a mean rating across all 64 items as well as a rating for each of the following: (1) noisy situations, (2) quiet situations with the speaker in close proximity, (3) situations with reduced signal information (e.g., talker's back turned, conversing in a reverberant room), and (4) situations with nonspeech stimuli (e.g., telephone ring).

RESULTS

Unaided Speech Recognition Measures

Mean results for the adaptive speech recognition testing with the three types of stimuli in the quiet condition are shown in Table 1 and are reported as the level of speech that was required for 50 percent correct recognition.

Mean data for the two noise conditions are displayed in Table 2. Results for the noise conditions are reported as the (S/Ns) at which 50 percent of the speech stimuli could be correctly recognized. A wide range of S/Ns for the noise conditions was obtained, indicating substantial variability in susceptibility to noise among the listeners in this study. A two-way analysis of variance (stimulus by level) indicated a significant stimulus effect [$F(2, 276) = 166.8$, $p < .001$] and a significant level effect [$F(1, 276) = 9.3$, $p < .01$]. There was also a significant interaction between these two variables [$F(2, 276) = 4.7$, $p < .01$]. Post hoc testing with the Tukey test indicated that all three stimulus means were significantly different from one another, with monosyllables requiring the least favorable S/N (−5.6 dB) and discourse requiring the most favorable S/N (+2.2 dB). With respect to noise level, paired t-tests revealed that significantly lower (better) SRTs were obtained at 25 dB SL noise level than at 90 dB SPL noise level for monosyllables and for the HINT sentences ($p < .001$). SRTs for discourse in the two noise conditions were not significantly different.

Correlation coefficients for the various measures in quiet and in noise are displayed in Table 3. High correlations were obtained among the three quiet SRTs, as would be expected, since these measures are dependent upon hearing thresholds. Modest correlations were seen between the quiet SRT for sentences and the SRT for sentences at moderate and high noise levels.

Table 3 Pearson Product-Moment Correlations for Speech Recognition Threshold Measures in Quiet and in Two Levels of Noise

	Quiet			*Noise at 25 dB SL*			*Noise at 90 dB SPL*	
	Monosyllables	*Sentences*	*Discourse*	*Monosyllables*	*Sentences*	*Discourse*	*Monosyllables*	*Sentences*
Quiet								
Monosyllables								
Sentences	.73***							
Discourse	.71***	.93***						
Noise at 25 SL								
Monosyllables	.05	.02	.19					
Sentences	.51***	.57***	.50***	.34*				
Discourse	.52***	.28	.44**	.46**	.47***			
Noise at 90 SPL								
Monosyllables	.10	.05	.08	.45**	.25	.20		
Sentences	.31*	.33*	.35*	.50***	.60***	.38**	.61***	
Discourse	.42**	.30*	.45**	.29*	.40**	.79***	.27	.47***

* p < .05; ** p < .01; *** p < .001.

Table 4 Mean Hearing Aid Performance Inventory Results

	Mean	*SD*	*Range*
Noise	2.4	0.6	1.4–4.1
Quiet	1.8	0.4	1.2–2.5
Reduced Cues	1.8	0.4	1.1–2.6
Nonspeech	2.0	0.4	1.1–2.9
Total	2.1	0.4	1.4–3.0

1 = very helpful, 2 = helpful, 3 = very little help, 4 = no help, 5 = hinders performance. Lower score indicates greater perceived benefit.

The same was true for the discourse stimuli. That is, for the sentence and discourse stimuli, subjects with relatively poorer hearing (i.e., higher SRTs in quiet) tended to require a more favorable S/N to obtain 50 percent correct recognition in noise. For monosyllabic words, quiet performance was not related to performance in noise. Generally, correlations among the various noise measures were modest, likely reflecting the increased variability among subjects when listening in noise.

Perceived Hearing Aid Benefit (HAPI)

Mean HAPI results are shown in Table 4. The mean rating for all 64 items was 2.1, indicating that, on average, subjects found the hearing aids to be "helpful." Overall, subjects reported that their hearing aids were most beneficial when communicating in quiet situations and in situations with reduced cues. The hearing aids were felt to be least beneficial in noisy situations. These results are similar to the HAPI data reported by Walden et al (1984) for a large group of experienced hearing aid users who were, on average, older (mean age 61.6 years) and had poorer hearing thresholds than subjects in the current study.

Relationship Between Unaided Speech Recognition Measures and Perceived Hearing Aid Benefit

The product-moment correlations between the speech measures and the results of the HAPI for the 47 subjects are shown in Table 5. No significant correlations were seen between SRTs in noise and perceived benefit from amplification as measured by the HAPI. The only correlations that were significant, albeit modest, were between SRTs obtained in quiet and the Reduced Cues subscale of the HAPI. That is, subjects who had poorer unaided hearing for speech in quiet reported relatively less benefit from their hearing aids in situations with reduced cues.

Perceived Hearing Handicap (CPHI)

For analysis purposes, the 25 scales of the CPHI were combined to create the following six composite scores: Communication Performance, Communication Importance, Communication Environment, Communication Strategies, Personal Adjustment, and Problem Awareness/Denial. The Communication Performance composite score is an average of the three scale scores for social, work, and home communication

Table 5 Correlations Between Hearing Aid Performance Inventory Results and Adaptive Speech Measures in Quiet and in Two Levels of Noise

	Noise	*Quiet*	*Reduced Cues*	*Nonspeech*	*Total HAPI*
Quiet					
Monosyllables	−.02	.14	.38**	.10	.12
Sentences	.13	.10	.50***	.15	.23
Discourse	.13	.08	.40**	.14	.20
+25 dB SL noise					
Monosyllables	−.11	.06	−.09	.09	−.05
Sentences	−.09	−.13	.26	−.09	−.06
Discourse	−.13	.13	.14	−.02	−.01
90 dB SPL noise					
Monosyllables	−.04	.03	.19	−.08	−.13
Sentences	−.19	−.05	.20	−.12	−.11
Discourse	−.12	.17	.17	−.04	−.00

** $p < .01$; *** $p < .001$.

Table 6 Mean Communication Profile for the Hearing Impaired Composite Scores

	Mean	*SD*	*Range*
Communication Performance	3.0	0.5	1.5–4.1
Communication Importance	3.5	0.5	2.1–4.9
Communication Environment	2.8	0.4	1.9–4.0
Communication Strategies	3.6	0.5	2.5–4.4
Personal Adjustment	3.3	0.5	2.3–4.7
Problem Awareness/Denial	3.7	0.6	2.0–4.6

For all scales except Communication Importance, a higher score indicates fewer problems. For the Communication Importance scale, a higher score indicates a greater perceived need to communicate effectively.

performance. The Communication Importance composite score was derived from the three scale scores that assess importance of effective communication in social, work, and home environments. The Communication Environment composite score is the average of the scale scores for communication need, physical characteristics of the environment, attitudes of others, and behavior of others. The Communication Strategies composite score is an average of the maladaptive behaviors, verbal strategies, and nonverbal strategies scale scores. The Personal Adjustment composite score was derived by combining the scores for the following scales: self-acceptance, acceptance of loss, anger, displacement of responsibility, exaggeration of responsibility, discouragement, stress, and withdrawal. The Problem Awareness/Denial composite score is the average of scores for the problem awareness scale and the denial scale. Scales were combined in this manner based on similarity of item content (Demorest and Erdman, 1986, 1987). Mean scores for the 47 subjects, displayed in Table 6, were comparable to the scores reported by Demorest and Erdman (1987) for a group of 827 patients.

Relationship Between Perceived Hearing Handicap and Perceived Hearing Aid Benefit

Pearson product-moment correlation analysis was conducted among the six composite scores from the CPHI and the scores from the HAPI. These are shown in Table 7. Significant positive correlations were seen between the CPHI Communication Performance composite score and the HAPI subscales that assess hearing aid benefit for quiet and nonspeech situations. That is, subjects who perceived greater unaided communication difficulty reported more benefit from the use of amplification when conversing in quiet situations and for hearing environmental sounds. These correlations were modest, with the Communication Performance score accounting for only 14 percent of the variance of the quiet subscale score and 12 percent of the nonspeech subscale score of the HAPI.

DISCUSSION

This study sought to determine whether unaided speech recognition ability in noise is related to perceived hearing aid benefit. We hypothesized that hearing-impaired individuals who demonstrated a greater susceptibility to noise interference (i.e., needed a more favorable S/N to achieve 50% correct speech recognition) would report less benefit from the use of amplification. There was substantial variability in susceptibility to noise among our listeners, as indicated by the wide range of SRTs obtained. However, there was no systematic relationship

Table 7 Correlations Between Hearing Aid Performance Inventory Results and the Communication Profile for the Hearing Impaired Composite Scores

	HAPI Scores				
CPHI Composite Scales	*Noise*	*Quiet*	*Reduced Cues*	*Nonspeech*	*Total HAPI*
Communication Performance	.07	.38**	.08	.34*	.23
Communication Importance	−.13	.04	−.12	−.01	−.10
Communication Environment	.12	.02	.02	.03	.09
Communication Strategies	−.04	−.06	−.02	.00	−.05
Personal Adjustment	.11	−.03	.02	.06	.08
Problem Awareness/Denial	−.13	−.13	−.06	−.04	−.14

* $p < .05$; ** $p < .01$.

between self-reported hearing aid benefit and speech recognition ability in noise for high-frequency monosyllabic words, the HINT sentences, or continuous discourse. The majority of subjects reported significant benefit from the use of hearing aids regardless of their speech recognition ability in noise.

Clearly, our subject group differs from the typical clinical population of hearing aid users with respect to age. We chose to enrol younger hearing-impaired adults to minimize possible confounding variables such as cognitive deficits or central auditory processing disorders that may exacerbate speech recognition difficulties in older patients (van Rooj and Plomp, 1990; Stach et al, 1991). Interestingly, findings similar to ours were reported by Kricos et al (1987), who evaluated hearing aid benefit for two groups of elderly hearing-impaired subjects. One group was classified as having primarily peripheral hearing loss and the other as having significant central auditory nervous system involvement. They postulated that subjects with central auditory dysfunction, presumably subject to significant internal distortion, would report less benefit from amplification. However, responses to the HAPI indicated that both groups of elderly subjects reported very similar benefits. Both our results and those of Kricos et al support the notion that poor speech recognition ability in noise does not limit perceived benefit obtained from hearing aids.

A second issue addressed by this investigation was whether subjects' perceived unaided hearing difficulty was related to self-reported benefit obtained from the use of amplification. One might assume that a person who experiences few communication difficulties without a hearing aid is not likely to gain a great deal of benefit from amplification. Subject ratings on the CPHI revealed that, on average, the participants in this study placed high importance on being able to communicate effectively, especially at work, and felt that high communication demands were placed upon them. Despite this, only weak correlations were seen between patients' perceived communication difficulties and the benefit derived from the use of amplification. None of the other factors assessed by the CPHI (importance of communication, personal adjustment to hearing loss, environmental factors, or denial of handicap) was related to hearing aid benefit for this group of subjects.

The findings of this study, in combination with previous studies that have attempted to identify predictors of benefit, suggest that the outcome of a hearing aid fitting may not be predestined to success or failure by factors beyond the realm of our rehabilitative efforts. In a recent study by Cox et al (1999), hearing aid users were asked to rate the relative importance of various elements of hearing aid satisfaction. The most highly rated element was a "knowledgeable and honest hearing health professional." Almost all of the hearing aid users in that study indicated that this element was "tremendously" or "greatly" important to satisfaction with their hearing aids. It is noteworthy that the relatively mildly hearing-impaired, first-time hearing aid users in the current investigation reported high benefit scores. Recall that subjects in our study attended a 3½-day rehabilitation program during which they received individual and group counseling regarding the benefits and limitations of amplification as well as training in communication strategies, speechreading, and stress management. The high benefit ratings may, in part, reflect the benefit obtained from the entire rehabilitation program and not just from the hearing aids themselves.

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