Further Investigation of the Relationship Between Hearing Handicap and Audiometric Measures of Hearing Impairment

Lisa L. Kielinen
ENT Specialists
Farmington Hills, Michigan

Michael A. Nerbonne
Department of Communication Disorders
Central Michigan University

Using some less conventional audiometric materials, protocols, and data, this study explored further the relationship between audiometric results and self-assessment measures of hearing handicap. Presenting the NU-6's and the California Consonant Test at conversational level and using two different best binaural pure tone averages did result in significant correlation coefficients between these measures and self-perceived hearing handicap, but the magnitudes of the coefficients were not appreciably greater than previously reported in the literature using more traditional audiometric measures. The relatively weak correlations from the present and previous studies collectively imply that audiometric tests and hearing handicap scales evaluate somewhat different aspects concerning an individual's hearing. Both provide unique and valuable information for successful patient management.

For some time, it has been acknowledged that self-assessment of hearing often can provide additional information of a meaningful nature about an individual's hearing difficulties which cannot be derived from conventional audiometric data. This has resulted in the development of a number of self-assessment scales of hearing handicap which presently are playing an increasingly important role in the overall audiologic management of hearing-impaired adults.

Extensive research efforts also have focused on various aspects of hearing handicap. One such area of investigation has involved exploring the degree to which routine audiometric threshold and speech recognition test results correlate with self-assessed hearing handicap and the extent to which hearing handicap can be predicted from audiometric data. Giolas (1982) presents a summary of the major conclusions reached on these issues in numerous investigations conducted in the past three decades.

Requests for reprints should be sent to Michael Nerbonne, PhD, Department of Communication Disorders, Central Michigan University, Mt. Pleasant, Michigan 48859.

In general, conventional measures of hearing sensitivity and speech recognition have been found to correlate to a mild-moderate degree with hearing handicap. However, for the most part only conventional audiometric protocols, materials, and data have been used in past studies to evaluate the degree of relationship between audiometric results and self-assessment scales. For instance, a common practice in evaluating the strength of correlation between hearing sensitivity and hearing handicap has been to use the conventional Pure Tone Average (PTA = 500, 1000 and 2000 Hz), for each ear or the best ear. However, other frequency combinations including high frequency representation, or the use of a Best Binaural PTA formula may be more relevant when attempting to predict self-perceived hearing handicap, due to the significant influence of hearing sensitivity in the 2000-4000 Hz frequency range and binaural hearing on consonant perception (Byrne, 1981; Gerber, 1974; Townsend, 1983).

Therefore, the purpose of this investigation was to explore further the relationship between various measures of standard and high frequency PTA, speech recognition and self-assessment data. These measures employ some less routinely utilized (and perhaps more relevant) audiometric materials, protocols and data which thus far have received little or no consideration in the literature.

METHOD

Subjects

Thirty adults, including 15 females and 15 males, served as subjects for this investigation. The subjects ranged in age from 18-85 years, with a mean age of 59.0 years (*SD* = 18.7). The subjects had varying degrees of sensorineural hearing loss that was bilaterally symmetrical in each case. None of the subjects used a hearing aid prior to the study.

Procedures

Pure tone air and bone thresholds were obtained at the octave test frequencies from 250-4000 Hz, with air conduction thresholds also being determined at 8000 Hz. In addition to a three-frequency Best Ear PTA (500, 1000, and 2000 Hz), two Best Binaural PTA's (500, 1000, 2000 Hz and 1000, 2000, 4000 Hz) also were determined.

Speech recognition abilities were assessed via Auditec recordings of Northwestern University Auditory Test No. 6 (Tillman & Carhart, 1966) and the California Consonant Test (Owens & Schubert, 1977). The latter list is unique in that it contains a much higher proportion of difficult-to-perceive consonants than other widely used speech recognition materials such as the NU-6's. Both lists were presented to each subject in a soundfield at a typical conversation level of 45 dB HL in quiet, rather than at a higher sensation level re the SRT, in an attempt to obtain a truer estimate of listener performance at an intensity more commonly encountered in everyday communication situations.

The Self-Assessment of Communication (SAC) (Schow & Nerbonne, 1982) was used to evaluate self-perceived hearing handicap. Its companion scale, the Significant Other Assessment of Communication (SOAC), was also given to each subject's spouse or companion.

RESULTS AND DISCUSSION

As shown in Figure 1, mean air conduction pure tone threshold data for the thirty subjects combined indicated a mild to moderate hearing impairment bilaterally, with

Table 1

Mean Best Ear and Best Binaural Pure Tone Averages in dB HL ($N = 30$)

	PTA Method		
	Best Ear (500, 1000, 2000 Hz)	**Best Binaural (500, 1000, 2000 Hz)**	**Best Binaural (1000, 2000, 4000 Hz)**
M	26.7	25.4	38.8
SD	12.9	12.7	15.1

primary involvement occurring for the test frequencies from 2000-8000 Hz. Table 1 contains the mean and standard deviation values for each of the three pure tone averages derived. Of the three, the high frequency Best Binaural PTA (1000-2000-4000 Hz) clearly reflected the most loss in hearing sensitivity.

Table 2 lists the mean word recognition and hearing handicap values obtained. Generally speech recognition performance at 45 dB HL was poor. This presentation level was specified in order to be consistent with typical conversation levels (Bate, 1980), rather than the level necessary to approximate PB max. The subjects also experienced considerably more difficulty with the California Consonant Test than the NU-6's, due presumably to the high frequency hearing loss of most subjects which caused loss of audibility for the high frequency phonetic cues which dominate the CCT stimulus items. Average hearing handicap scores from the SAC and SOAC were quite similar and indicate a moderate overall amount of hearing handicap (Schow & Tannahill, 1977).

Pearson r's were calculated between the audiometric and hearing handicap measures, and these are provided in Table 3. Overall measures of hearing sensitivity (the PTA's) were found to correlate significantly with both scales of hearing handicap, which has been demonstrated previously (Giolas, 1982). However, the Best Binaural PTA's correlated more strongly with hearing handicap than the Best Ear PTA. This was particularly true for the high frequency Best Binaural PTA.

In spite of the fact that the correlation between the CCT and the SAC managed to achieve statistical significance, the overall strength of relationship found in this investigation between both tests of word recognition and hearing handicap is best described as weak and basically non-significant for the purpose of reliable placement of individuals into diagnostic categories. These results are similar to those reported previously re word recognition performance and self-reported hearing handicap (Giolas, 1982; Weinstein, 1984).

Table 2

Mean Word Recognition and Hearing Handicap in Percent ($N = 30$)

	NU-6	**CCT**	**SAC**	**SOAC**
M	65.8	43.7	44.9	43.2
SD	28.4	16.2	23.8	26.6

Note. NU-6 = Northwestern University Auditory Test No. 6, CCT = California Consonant Test, SAC = Self-Assessment of Communication, and SOAC = Significant Other Assessment of Communication. High SAC/SOAC scores indicate more hearing handicap.

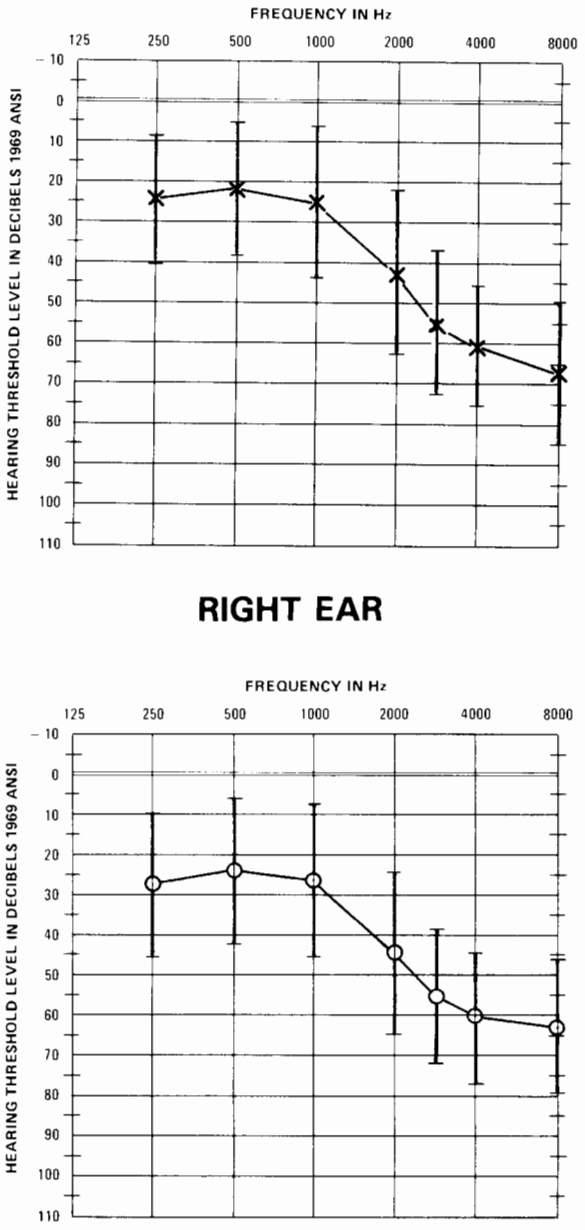

Figure 1. Mean pure tone air conduction thresholds in dB HL for all 30 subjects. The vertical bars represent ± 1 S.D.

Table 3

Correlations Between Self-Report Hearing Handicap (SAC and SAOC) and Measures of Word Recognition and Pure Tone Average ($N = 30$)

	Handicap Scale	
Audiometric Measure	**SAC**	**SOAC**
NU-6	−.35	−.34
CCT	−.36	−.34
Best Ear PTA (0.5K, 1K, 2K Hz)	.41*	.41*
Best Binaural PTA (0.5K, 1K, 2K Hz)	.45**	.45**
Best Binaural PTA (1K, 2K, 4K Hz	.49**	.55**

* $= p < .05$.
** $= p < .01$.

SUMMARY AND CONCLUSIONS

While the results of this investigation must be interpreted carefully in light of factors such as the range of hearing loss and ages of the subjects used and the particular materials used to assess word recognition and self-perceived hearing handicap, some conclusions do appear warranted.

Although all of the less routinely employed PTA methods elected for use in this study, particularly those using a best binaural PTA and/or a 1000-2000-4000 Hz PTA, yielded values which correlated significantly with measures of hearing handicap, the strength of relationship does not appear to be any stronger than previously reported with conventional PTA approaches. Similarly, the use of a specialized word recognition test which emphasizes the perception of high frequency phonetic cues (CCT) did not result in a stronger correlation between word recognition and hearing handicap than found in the past with more conventional word recognition test material, such as the NU-6 test. Evaluating word recognition at a normal conversation level (45 dB HL) rather than at a high sensation level re the SRT also did not produce correlation coefficients between word recognition and hearing handicap which were of a greater magnitude than already reported.

In summary, results of this study, as well as virtually all of the related investigations which preceded it, lead us to the conclusion that PTA's and speech recognition performance, whether obtained conventionally or otherwise, simply do not enable one to predict hearing handicap SAC/SOAC scores with sufficient strength to be of clinical utility for individual client management. Audiometric tests used in this study appeared to provide information that was different from that provided by the self-report hearing handicap scales; i.e., at best, 30% of the variance in the SAC/SOAC scores was predicted by the Best Binaural PTA ($r = .55$; $r^2 = .30$). Therefore we recommend the use of the SAC/SOAC as a means to identify an individual's unique handicap and need for aural rehabilitation which would otherwise be unpredictable from these audiometric tests.

Given that speech communication and its interaction with hearing loss is a complex event, further, multivariate-type studies are needed to illuminate the relationships between

various audiometric measures/measurement conditions and self-reported hearing handicap. Combining uncorrelated audiometric measures in a multiple regression study might improve the prediction of self-reported hearing handicap. Also, in the future, other, less-frequently used measures of speech-recognition-in-noise and psychoacoustic measures such as frequency and temporal processing may prove useful in the prediction of hearing handicap.

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