Subjective and Objective Correlates in a Hearing Aid Evaluation Procedure

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Ross (1972) in a review of the literature concerning hearing aid evaluation procedures reported several different clinical methods which have been used to guide the audiologist in selecting the most appropriate amplification for their hearing impaired clients. According to a survey done by Burney (1972), the most popular of these methods used in clinics today is the Carhart method which was first described in 1946. Nearly 85 percent of the more than 200 clinics responding to Burney's questionairre used the Carhart approach with relatively few modifications as the basic hearing aid evaluation procedure.

Essentially this method of hearing aid evaluation explores four dimensions of hearing aid performance; effective gain, tolerance limits, efficiency in noise and word discrimination. In this procedure, selection of a specific hearing aid for the client is made on the basis of a compilation of scores obtained on several instruments from tests designed to measure these four aspects of hearing aid performance. If scores happen to be similar for two or more aids tested, factors such as size of the aid, its weight, its esthetic qualities and its cost often come into the picture to help the audiologist make the decision as to which aid should be recommended for purchase.

Only recently has consideration in the literature been given to other ways of determining which is the "best" of two similarly performing hearing aids. One suggestion that has been made is that subjective evaluation, that is listener judgement, be used as an indicator of the efficiency of the hearing aid (Zerlin, 1962; Witter and Goldstein, 1971). The difficulty in using listener judgement as a reliable indicator of efficiency is that we are not sure of just how reliable the judgement really is. However, to this point in time, we have been unable to resolve those seemingly unmeasureable effects that cause a person to choose one aid in preference to another. Yet the importance of listener preference persists.

Ross (1972), Burney (1972) and Chaiklin and Stasson (1968) have suggested that clinical observation seems to bear out a positive correlation between "best" performance and listener preferance but that too little systematic investigation has been reported in this area.

Method

The purpose of this study was to investigate the question of listener preference as a factor in the hearing aid selection process. A hearing aid evaluation procedure was studied in which subjective preference for amplification was compared with objective results in an ideal listening situation and in listening situations contaminated by two kinds of noise.

Subjects Subjects were twelve male veterans of the United States armed ser-

vices who had sustained hearing loss during or as a result of, their tours of duty. Each was eligible to recieve a hearing aid through the Veterans Administration and was being seen for this purpose at the Audiology Clinic in the Veterans Administration Hospital at Ann Arbor, Michigan. Ages of the subjects ranged from 22 to 70 years. Pure tone audiometric configurations allowed the subjects to be placed into one of three categories; a mixed loss group, a group with a sensori-neural percipitous loss of hearing acuity beginning at 2000 Hertz, and another group with a more gradual loss of sensitivity throughout the test frequencies.

Procedure Testing was done in a double walled IAC testing suite in the clinic. The equipment used consisted of a Grason-Stadler speech audiometer, model 162, and its associated amplifier and speaker. Taped CID W-22 word lists were used as the speech discrimination test material and were played through the Grason-Stadler system from a Viking 423 tape deck. The noise source was the black channel of the speech audiometer set at either the wide band white noise or the speech spectrum white noise condition.

The two "best" performing hearing aids as determined by the traditional Carhart approach were selected for each subject. The performances of these two aids were compared according to the following protocol: 1. Speech reception thresholds; 2. Speech discrimination scores in quiet at a 40 decibel sensation level re: SRT; 3. Speech discrimination scores in wide band white noise with a signal to noise ratio of 1:1 at 40 dB SL; 4. Speech discrimination scores in speech spectrum white noise with a signal to noise ratio of 1:1 at 40 dB SL; and 5. The veteran's subjective evaluation, or ranking, of the two aids according to his impression of the quality of the signal as he compared the aids in the quiet listening environment.

Results and Discussion

The means for each patient group reported in Tables 1 and 2 show that the speech reception threshold scores and the speech discrimination scores were essentially the same in quiet for the two aids although subjects in each category were easily able to rank them according to quality of the amplification.

Table 3 shows that discrimination scores in the wide band white noise contamination condition had a mean difference of 14.3 percent between the first and second ranked aids for the total group of subjects whereas the discrimination scores in speech spectrum white noise were markedly reduced for both hearing aids for all three hearing loss categories. It is of great interest to note that eleven of the twelve subjective preferences for the aid with the best sounding quality were in agreement with the best objective performances in wide band white noise contamination.

In a traditional hearing aid evaluation procedure it is appropriate and necessary, for selection of the most efficient amplification as well as for counseling purposes, to include a measurement of hearing efficiency in a less than ideal listening environment. A listening environment in which wide band white noise is used seems to serve this requirement quite well and is easily available to the clinician in a traditionally equipped audiology clinic. Because of the greater sound pressure levels associated with speech spectrum white noise at various attenuator dial settings, it appears from the results of this

Table I. Mean aided SRT scores and differences between Aid 1 and Aid 2 in each of the type of hearing loss groups and for the total sample in dB re: HL.

GROUP	AID 1	AID 2	DIFFERENCE
Mixed	16.67	16.67	0
S/N P.	8.0	10.0	2
S/N G.	15.43	15.14	.29
Total*	14.50	14.66	.16

* Means from actual scores of all subjects.

Table 2. Mean discrimination scores and differences in Quiet for Aid 1 and Aid 2 in each type of loss group and for the total sample.

GROUP	AID 1	AID 2	DIFFERENCE
Mixed	85.33%	90%	4.67%
S/N P.	85.0%	81%	4%
S/N G.	86.0%	79.71%	6.29%
Total	86.50%	81.66%	4.84%

Table 3. Mean aided discrimination scores and differences in wide band white noise and in speech spectrum white noise at signal to noise ratios of 1:1 for Aid 1 and Aid 2 for each type of loss group and for the total sample.

	GROUP	AID 1	AID 2	DIFFERENCE
Wide Band White Noise	Mixed	64%	29.33%	34.67%
	S/N P.	66%	48%	18%
	S/N G.	57.71%	50.85%	6.86%
	Total	60%	45.66%	14.34%
Speech Spectrum White Noise	Mixed	28%	12%	16%
	S/N P.	40%	28%	12%
	S/N G.	36%	26.29%	9.71%
	Total	33%	24.66%	8.34%

study that this type of noise at the 1:1 signal to noise ratio is almost totally devastating to the discrimination ability of the hearing impaired listener in both aided and unaided conditions. While dial readings are the same for the two types of noise, sound pressure levels at the component frequencies are quite different. The results of the present study indicate that wide band white noise contamination at 1:1 signal to noise ratio effectively differentiates between hearing aid performances which were not differentiated in the quiet environment. In addition, eleven of the twelve (91.6 percent) subjects in the study showed subjective preference for the aid which performed best on the objective wide band white noise measurements.

In view of the current controversy regarding the dispensing of hearing aids by audiologists it becomes apparent that any improvement in techniques of hearing aid evaluation would be to the advantage of the clinician. And as Ross (1972) suggests, until electroacoustic methods of determining the best aid for an individual become available, up-dating the present procedures with modifications of the traditional approaches to hearing aid evaluation seem to be in order. Noise studies in conjunction with the client's subjective preference for an aid seem to give useful information to the audiologist in this regard.

Summary

A hearing aid evaluation procedure was studied in which subjective preferance for amplification was compared to objective test results obtained in an ideal listening situation and in listening situations contaminated by two kinds of noise. Wide band white noise contamination was found to effectively differentiate between hearing aid performances which were not differentiated in the quiet environment. 91.6 percent of the population of the study showed subjective performances in quiet for the aid which performed best on the more objective wide band white noise measurements.

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