

# **A REVIEW OF HEARING AID FITTINGS ON YOUNG ADULTS WITH SEVERE TO PROFOUND HEARING IMPAIRMENT**

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Each year approximately 30% of the student population at NTID require new hearing aid fittings. Ten percent of this group may be classified as "difficult to fit" and require a special program of ongoing hearing aid evaluation, orientation, and counseling to optimize their chances for success. This program is known as "Orientation to Hearing Aids" (OHA) and is provided to the student throughout a ten-week academic quarter. The objective of the program is to provide the conditions necessary for the student to experience benefit from amplification, such that he desires to use his own hearing aid on an "all" or "most of the time" basis. This report describes the population, the amplification characteristics of the hearing aid fittings, and the success of the program; it also reviews the gains made in receptive communication skills (speechreading without sound, speechreading with sound, and speech sound discrimination) following the ten-week period of hearing aid use.

**POPULATION.** A total of 64 students were serviced by the Hearing Aid Orientation program from Fall 1972 through Spring 1974. The students involved fell into two general groups: 31% had limited or no experience using a hearing aid and; 69% had used hearing aids previously, but had stopped using them. In the second group, all but 4 had used body aids. The major complaint in 90% of the cases (where body aids had been used) was that the hearing aid caused headaches, dizziness, or made sounds uncomfortably loud. The remaining 10% complained of the physical and aesthetic aspects of body borne amplification. For the 6% who had used ear-level aids, complaints were related to either insufficient or excessive gain and acoustic feedback. The total population may be described as a difficult to fit population not only because of the auditory factors involved, but also because of the psychological attitudes which had developed from frequently very negative experiences with hearing aids.

Hearing loss for the total population (N=64) ranged from moderately severe (Pure Tone Average = 65dB HL ISO) to profound (no response to any pure tone signal at maximum intensity limits of the audiometer). Thirty-four (53%) of the students had sufficient hearing throughout the speech range on which to compute a conventional pure tone average (PTA). The average loss (better ear) of this group was 90 dB HL (ISO). Of the remaining 30 students, 10 (16%) possessed residual hearing for two of the speech frequencies (500,

1000 Hz.), 13 (20%) demonstrated residual hearing for one of the speech frequencies (500 Hz.) and seven or 11% of the population had no measurable hearing on the audiogram. These groups shall be referred to as Groups A, B, V, and D, respectively.

#### HEARING AID FITTING PROCEDURES AND RESULTS.

Because of the nature of high incidence of difficulties reported in individual interviews and a questionnaire given to students previously using aids, procedures were developed to carefully analyze the gain requirement (HAIC) and maximum tolerable Sound Pressure Levels for each student. This information was used directly in the selection and fitting process with the objective of providing a "comfortable fitting." Frequency response also appeared to be important with our population, but this will not be discussed here as our study is incomplete.

Measures of Most comfortable Loudness (MC) and Uncomfortable Loudness (UCL) were used to determine the amount of hearing aid gain and Maximum Power Output (MPO) appropriate for each student. The MCL result was used in determining the appropriate amount of gain required for the student to hear speech at a comfortably loud level and the UCL measure was used to define the MPO which the student could comfortably tolerate. The range between these measures is referred to as the student's comfortable listening range and its expanse is crucial to the hearing aid fitting process.

An average Sound Pressure Level (SPL) of 114dB was required to produce a "most comfortable" listening sensation in 55 of the students. (This measure could not be obtained for 9 students as the maximum limits of the particular audiometer was 120dB SPL and this was not sufficient to produce comfortable listening.) Individual MCL results were examined for their relevance to conversational speech by looking at the relationship between the MCL measure and speech at average conversational level (65dB SPL). We were interested in the amount of amplification which, when added to the speech signal, made it comfortably loud to the hearing impaired ear. The amount of gain needed would then correspond to the decibel difference between speech at conversational level (65dB SPL) and speech at a comfortable loud level. Needed gain = MCL (re:SPL) minus 65dB. To confirm this contention, each student was asked to set his hearing aid volume at a comfortable listening level while cold running speech was presented at a level of 65dB SPL through the speaker at a distance of 3 ft. The hearing aid was then removed without changing the volume setting and a B & K measurement of hearing aid gain (HAIC) determined. It was found that the HAIC gain which the student established corresponded well (within  $\pm 6$ dB) to the estimated "needed gain" based on the formula (Needed gain = MCL - 65) for all students except those with sharply falling or rising losses who, under the flat amplification of earphones, appeared to adjust the speech signal to the comfortable level of the best perceived tones. Once they listened to speech with a hearing aid that offered an appropriate fre-

quency response, they accepted more pressure readily. This situation is well known clinically. The point here is that the traditional notion of required hearing aid gains does not work with this population. A more specific analysis of comfort and discomfort for individual frequency regions is required before "gain" can be determined. The over-all, average MCL for 55 students was 114 dB SPL; the average gain needed for this group was 50dB. Average gain requirements for each group were as follows: Group A = 49dB; Group B = 53dB; Group C = 55dB; Group D = 60dB. These results indicate that as hearing loss increases, there is an increase in the amount of amplification needed. However, the amount of increase is not as great as might be expected. Between the two most divergent groups, with regard to residual hearing (Groups A and D), there was only 11dB additional gain required by Group D.

Maximum power output was, in almost all cases, determined by the UCL measure and the hearing aid was adjusted so that it did not deliver sound pressure beyond this point. UCL was measured by gradually increasing the Sound Pressure Level of Cold Running Speech (Rainbow Passage) to the level at which the speech was "uncomfortable." This was repeated three times and the average level was taken as the UCL. The ranges of discomfort among 63 students were as follows: 110 - 119dB SPL (7 students); 120 - 129dB SPL (35 students); 130dB SPL (21 students). In the first category, 5 out of 7 students were from Group A, 1 in B, and 1 in C. In the second category, 15 were in Group A, 6 in B, 10 in Group C and 4 in Group D. In the third category, 13 students were from Group A, 2 from B, 3 from C and 3 from D. This distribution is illustrated in Table 1.

TABLE 1: Ranges of discomfort (UCL) for cold running speech, according to high frequency cut-off category (N=63)

		dB SPL		
		110-119	120-129	130
Residual Hearing for 500, 1000, 2000 Hz	GROUP A	5	15	13
Residual Hearing for 500, 1000 Hz	GROUP B	1	6	2
Residual Hearing for at 500 Hz	GROUP C	1	10	3
No measurable hearing	GROUP D	0	4	3
% of TOTAL POPULATION		11%	56%	32%

These results would suggest that the majority (56%) of these students began to experience discomfort within the same range that "normal" listeners do. Eleven percent showed reduced tolerance relative to the "normal" ear, and 32% showed an extended capacity to

listen at levels louder than the normal ear can tolerate. Further investigation of this factor needs to be done to determine the implications relative to site of lesion, prognosis for improvement of auditory discrimination with a hearing aid, and to better understand its relationship to other audiometric descriptors.

**AIDED HEARING.** The mean aided puretone warble tone, NBN averages were as follows: Group A - 41dB HL; Group B - 46dB HL; Group C - 46dB HL; Group D - 54 dB HL. This information suggests that all students in Group A were brought close to the "mild-loss" range of hearing, with their hearing aids. Those students in Group B and C were brought into the "moderate loss" category. ALL students were able to hear speech sounds, with varying degrees of discrimination ability at normal conversational levels from a distance of three feet.

**COMMUNICATION SKILLS.** Since the inception of "OHA", it has been one of our interests to determine if students demonstrated any spontaneous improvement in receptive communication skills after using appropriate hearing aid amplification over the academic quarter. Therefore, prior to, and upon completion of the hearing aid programs, students were given CHABA\* tests which measured speechreading ability without sound, speechreading ability with sound, and auditory discrimination of speech. Seventy-six percent of the population (N=22/29) showed improvement in the speechreading without sound category, with an average gain of 8.8% being obtained for each student.

TABLE 2: Speechreading Without Sound: % of improvement demonstrated on post tests using CHABA films (N=22)

	0-5%	6-10%	11-15%	16-20%	21-25%
GROUP A	5	4	3	1	1
GROUP B	1	1	0	0	1
GROUP C	2	0	1	0	0
GROUP D	1	1	0	0	0

The average percent of improvement within each group was as follows: Group A - 9%; Group B - 12.7%; Group C - 6.7%; Group D - 5%. Evaluation of the speechreading with sound post tests showed significant gains for 77% of the students with an average gain of 12% for each of these students. Table 3 documents the amount of improvement (%) for students in each group. The average percent of improvement within each group was as follows: Group A - 13.1%; Group B - 13%; Group C - 10.8%; Group D - 8.3%. As indicated, 23% of the population showed no appreciable gains at the end of the quarter in this area. The percentage of students showing improvement within each group were as follows: Group A - 80% (12/15 stu-

dents); Group B - 71% (5/7 students); Group C - 75% (6/8 students); and Group D - 80% (4/5 students).

TABLE 3: Speechreading With Sound: % of improvement demonstrated on post tests using CHABA films (N= 27)

	0-5%	6-10%	11-15%	16-20%	26-30%	
GROUP A	1	6	1	2	0	2
GROUP B	1	1	1	1	1	0
GROUP C	1	3	1	1	0	1
GROUP D	0	4	0	0	0	0
TOTAL	3	14	3	3	1	3

The results would tend to demonstrate that all groups showed some improvement in their speechreading with and without sound abilities after using a hearing aid for one quarter. In terms of hearing discrimination, 15 students moved up one profile rank by the end of the quarter. Hearing discrimination for speech was evaluated at 5 levels: awareness; same-difference discrimination of vowels; spondee discrimination, and sentence discrimination. A profile rank was assigned at each level of competency: Profile I (awareness) through Profile V (90% to 100%) on CHABA Sentence Lists. Eight of these students were in Group A (53%); 2 were in Group B (13%); 4 were in Group C (27%); and 1 was in Group D (7%). In terms of the percentage within each group that showed improvement, the results are as follows: Group A - 24%; Group B - 20%; Group C - 31%; Group D - 14%. Sixty-seven percent of the students showing improvement moved from Profile I to II; 26% from Profile II to III; and 6% from Profile IV to V. These results would support further the evidence that there does exist some meaningful index of "spontaneous" improvement in communication skills with hearing aid use.

COURSE OBJECTIVE. The degree to which the course has met its objectives was measured in large part by the number of students requesting their own hearing aids upon completion of the course. Of a total enrollment of 64 students, one came with a hearing aid appropriate to his needs and 3 students withdrew from school prior to hearing aid disposition. Of the remaining 60 students, 52 (87%) requested their own hearing aids at the end of the course. This is a strong indication that the student's amplification and counseling needs were well met by this program. To follow up hearing aid usage, questionnaires will be sent to students six months after procurement of the new aid. One of the major areas of concern will involve frequency of hearing aid use. This information should provide a clearer indication of how closely the long range objective of the course is being met.

DESIRE TO USE A HEARING AID: GROUP COMPARISONS. The percentage of students within each group who desired their own

hearing aids at the end of the course was as follows: Group A - 75%; Group B - 90%; Group C - 92%; Group D - 86%. The statistics on this small population would suggest that all 4 groups stand very favorable odds of experiencing "successful hearing aid fittings." Needless to say, the advantages of hearing aid use are very different from group to group. However, the rate of acceptance is as good or better among the students with poorer hearing as it is among those with the best hearing. These findings would suggest that all students, regardless of the extent of their hearing loss, be considered for hearing aid evaluation and orientation programs if they have a genuine interest and are willing to try. This last factor is very critical to the successful hearing aid experience.

HEARING AID STYLE. Present ear-level hearing aids are capable of providing substantial "gain" or amplification. Some high-gain ear-level instruments produce a maximum power output of 136dB SPL. This output was above the threshold of discomfort for at least 67% of the population evaluated in the NTID hearing aid orientation program. The need, therefore, to use body instruments, which were recommended in the past mainly because of their high-gain characteristic, does not exist for a great majority of "deaf" students. Out of a total of 52 hearing aid recommendations made, only 5 recommendations were made for body worn amplification. All others (90%) were for ear-level aids.

SUMMARY. The purpose of this report has been to document some of the findings which have come to light regarding hearing aids and their application to the NTID deaf student population. The information presented was compiled from evaluation of pre-and post tests administered in the Orientation to Hearing Aids Course throughout the period 9/72 through 6/74. Continuing investigation and collecting of data is imperative to the overall improvement of hearing aid fitting services to our students.