Trends in the Use of Amplification

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At the outset, this paper is primarily concerned with amplification in the form of auditory training units. It is the result of the concerns of an Ad Hoc Committee on Amplification of the Academy of Rehabilitative Audiology. Because of the similarity of problems, there will be occasional referral to experiences with individual hearing aids not designed solely for educational habilitation of the hearing impaired.

If one's goal is to utilize auditory training units effectively in the educational habilitation of the hearing impaired, he must have a knowledge of each device's capabilities and limitations. It is evident, however, that such information is not readily available from the manufacturers of such instruments (2). A review of the manufacturers' printed information brochures on twenty-eight models showed that ten listed no information about the maximum power output of the models. Ten others failed to give any indication of the frequency response. There was much greater emphasis placed on the convenience for the teacher, the ease of storage and speed of setting up the units or charging batteries. It is evident that there is a need for uniform specification procedures if adequate comparisons are to be made. Because of the complexity of the technical aspects of measurement, this area and the detailed recommendation of particular levels of performance are not discussed in this paper.

As with individually worn hearing aids, there should be a specified uniform description of auditory training units if one is to be able to compare models to determine if a given unit is performing properly. The recommendations herein are based on measurement of overall acoustic

output under various conditions of acoustic input. The variety of components between initial input and final output is such that present standards for measurement are unlikely to cover all current units. For example, there is no standard for measuring the output of circumaural earphones. The following recommendations presume that such techniques can be developed and should follow the standards for individual hearing aid characteristics as ASA STD 7-1976 (ANSI S3. 22-1976). It is important to note that a number of variable factors can dramatically affect a system's overall response, for example, microphone location and performance variation as a function of distance between components in an FM system or subcomponent orientation in a loop system.

In the publications, output information should be displayed graphically in the same manner as it is with individual hearing aids relative to frequency.

The saturation sound pressure level for 90 dB input sound pressure level (SSPL90) should be specified for the entire system with variations for different microphones and other components such as teacher units or student units defined. Any factors affecting performance should be specified. Any change in frequency response with variations in gain should be graphically shown.

Clinical Problems with Group Amplification: For the moment, consider the actual impact on the child under amplification of the group type. Many of the units have a maximum power output of 140 dB without compression or limitation. This level is reached when using the insert type earphone. Such amplitude has been proven harmful, to say nothing of the adverse psychological effect it may have on a youngster who has had no control or who has even been forced to wear the training unit at a gain setting which is intolerably high for him. In the past, both with classroom units and individual hearing aids, one is aware that many audiologists and teachers of the hearing impaired have recommended a specific setting be used without truly knowing or understanding whether or not that specific youngster has recruitment of a degree that produces a very narrow dynamic range. Years ago, if one body aid did not bring the child's awareness to near normal, it was common to try a more powerful aid, regardless of the frequency response.

Tolerance Problems: Many of the failures in hearing aid use in adults are felt to be the result of improper fitting and the distorition caused by an overpowering signal. Many individuals have ears just slightly different as one looks at the pure tone thresholds. It has been all too common for both audiologists and teachers to introduce sound at relatively equal levels on a "Y" cord basis, without individual controls of the level to the independent ears. Judgement has been based on the acuity for pure tones when the severity of the loss was so great, or training so limited, that the

usual discrimination (3) tests were difficult or impossible. With maturity and experience, we have learned that we have all too frequently forced too high a level of sound into an ear which distorted enough when compared with the other ear that it actually interferred with the total score with both ears functioning.

Binaural Versus Monaural Performance: Let me cite the case of a young girl in a nearby program for the hearing impaired. She had originally been fitted with a body instrument and a "Y" cord for her symmetrical pure tone loss averaging 65 dB. Accurate speech scores were not possible in the beginning. An alert teacher had commented about her apparent discrimination problem. As her training continued and availability of new ear level hearing aids offered the possibility of a true binaural fitting, she was re-evaluated in detail. Now able to respond to discrimination tests, it was discovered that one ear scored 60% the other 0% and a binaural test resulted in 24% discrimination. Very obviously the poorer ear in speech discrimination was interfering with her overall performance with amplification. The auditory training unit in her class was removed from the poorer ear, and the teacher noted an increase in her performance in class. Two other very severely deafened youngsters with similar but not identical pure tone results on the two ears had been described as having more than the usual amount of difficulty in learning speech sound identification without the visual supplement. This was true either with the classroom training unit or with their own hearing aids, all of which were set up in "Y" cord fashion. This year we were able to do a modified discrimination test using familiar spondees at suprathreshold levels. The PBK lists were utilized after persuading the boys that they should attempt to imitate any sound they heard. In both cases, one ear scored more suprathreshold spondees and far more "near-misses" or more of the phonetic elements in the words without actually getting the word than the other. They are dropping the "Y" cord on their own instruments and also using only the better ear with the auditory training unit. The teacher will be observing them closely for any changes in their functioning with speech. One cannot predict from the pure tone pattern and threshold alone in the recommendation of the hearing aid fitting. The individual hearing aids must be tried and attempts made to determine the relative clarity of the speech signal on each ear and on both. In the same manner one should be able to experiment with the student in terms of his performance on the auditory training unit. The good educator of the deaf is always on the alert for variations in even day-to-day behavior with amplification. Not all do better binaurally as has been suggested (1). A great number do, but this is an individual thing and must be evaluated very closely.

Most Comfortable Loudness Settings: Children have a tendency to set

their own hearing aids and training units at a level comfortable for them, if properly motivated and trained. Frequently we have observed the youngster's setting of a body instrument so that the aided speech reception threshold is roughly between 40 and 45 dB. With ear level trials it has often been possible to duplicate or better this score. One can force the utilization of a higher setting and better threshold, but the distortion for that specific individual may be so great that it destroys any advantage one might expect from a more nearly normal threshold. For this reason, we have urged audiologists and educators to strive for a level that will mean educability and not reach for normal. Even the mild sensorineural losses do not always function well when pushed to the 10 dB level. They may adapt and function effectively at a 15 to 25 dB level making adjustments as they feel the need. In testing experienced hearing aid users, including the very young, it has been noted by one of the authors that given the opportunity to set each separate instrument they invariably score speech reception thresholds within one or two dB with all the instruments.

In many cases, we have encountered long-time body hearing aid users whose actual scores with ear level instruments proved they could function as well as with body type. However, they have grown so accustomed to the amplitude and response of their older body instrument that they did not think there was enough impact or power to warrant any change. On the basis of their earlier training and experience, many of the more severly deaf have often demanded the impact of higher amplitude without being aware of any possible difference in the clarity of the signal.

None of the above can be considered a research study. These are merely observations that suggest many problems, many unknown factors which need better control, knowledge and understanding on the part of those who must function as effectively as possible with auditory training units and other types of amplification. Again, there is no substitute for observing the individual and his personal coupling with amplification of any kind.

In summary, with auditory training units we need to be able to control maximum power output for each individual student. With a single ear fitting there must be an easily adjustable gain control as well as variations in frequency response. When the final acoustic output is a "Y" cord type there should still be separate balance controls to the two ears although a single amplifier would preclude any frequency variation to the two ears. With the binaural arrangement there needs to be variable gain and variable frequency response for the greatest compatibility with the loss. Where possible, one should check discrimination with different settings as one would with separate hearing aids to be tried. One study reviewed the apparent success of an FM type unit in creating better speech under-

standing (4). This referred specifically to the teacher, and yet there are obvious limitations to units with a teacher's microphone only or a table mike to be shuttled from student-to-student. With a variety of classmates, voice levels may vary, distance and classroom ambient noise may interfere. It is felt that units are needed which permit not only hearing each other with the passage of a mike, but also the constant awareness of hearing classmates and monitoring his own voice with the use of mikes built into the student units. There needs to be freedom from cords, freedom from the limitations of a loop system so the student is able to move from the classroom out-of-doors for all the language input available there.

Let the manufacturers hear these needs. Let them produce the equipment which is most helpful in the habilitation of the hearing impaired, and then let them describe accurately, specifically and consistently what each unit can do. With that in hand, it will be possible to organize workshops to help everyone learn what can and should be done to utilize auditory training units more effectively.

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