LETTERS TO THE EDITOR

Neglected Issues in Educational Audiology

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A dearth of diagnostic and rehabilitative audiology services available to children in schools has prevented all but 1% of children with hearing loss from receiving appropriate hearing management. This article urges audiologists to take a proactive role in providing inservice training to school personnel and implementing technology to enhance the signal-to-noise ratio in school settings.

Mainstreaming, a form of integration, means access to opportunity (Safford, 1989, Chapter 1). The facilitation of mainstreaming/integration for children with any disability is good and valuable (Code of Federal Regulations on Education, 1986). Eight million of the 39.5 million U.S. school children have some degree of hearing loss, and their mainstreaming success is largely predicated on the management of their hearing losses (Berg, 1986a; Ross & Giolas, 1978). Audiologists are the primary experts on hearing and hearing technology. Unfortunately, there are only approximately 700 audiologists employed in school settings, far too few to manage more than a fraction of the children with hearing loss (Bess & McConnell, 1981, p. 205; Wilson-Vlotman & Blair, 1986). The purpose of this article is to heighten the awareness of audiologists as hearing advocates, and as providers of the services and technology necessary to facilitate successful mainstreaming of children with all degrees of hearing loss.

THE LAW

A precursor to successfully advocating for hearing and for children with hearing loss is knowledge of the audiologic services mandated by law. According to the Code of Federal Regulations on Education, Title 34, Section 300.13 (1986), "audiology" includes:

> (i) Identification of children with hearing loss:
> (ii) Determination of the range, nature, and degree of hearing loss, including referral for medical or other professional attention for the habilitation of hearing:
> (iii) Provision of habilitative activities, such as language habilitation, auditory training, speech reading (lipreading), hearing evaluation, and speech conservation:
> (iv) Creation and administration of programs for prevention of hearing loss:
> (v) Counseling and guidance of pupils, parents, and teachers regarding hearing loss: and

(vi) Determination of the child's need for group and individual amplification, selecting and fitting an appropriate aid, and evaluating the effectiveness of amplification. (p. 14)

Title 34, section 300.5 of the Code (1986) defines "Deaf" as "a hearing impairment which is so severe that the child is impaired in processing linguistic information through hearing, with or without amplification, which adversely affects educational performance" (p. 12). "Hard of Hearing" is defined as "a hearing impairment, whether permanent or fluctuating, which adversely affects a child's educational performance but which is not included under the definition of 'deaf' in this section." (p. 12). The startling fact is that children with all degrees of hearing loss, permanent or fluctuating, are entitled *by law* to audiologic diagnostic and rehabilitative services, yet these services are not available to 99% of the children who have hearing loss!

THE IMPORTANCE OF HEARING AND HEARING LOSS

Hearing

One of the primary reasons why audiologic services have not been made universally available is that many school personnel lack basic knowledge about the importance of hearing to the educational process (Lass et al., 1986; Martin, Bernstein, Daly, & Cody, 1988). Indeed, classrooms are auditory-verbal environments (Simon, 1985). Hearing and listening form the cornerstone of the educational system; instructional information is presented through the speech of the teacher with the underlying assumption that children can hear and attend to the teacher's voice. Because children spend a great deal of their classroom time engaged in active listening activities, the need for *all* children to be able to hear clearly must not be underestimated (Berg, 1986a).

Elliott, Hammer, and Scholl (1989), when testing normally hearing children, found that the ability to perform fine-grained auditory discrimination tasks (e.g., to hear "ba" and "pa" as different syllables) classified almost 80% of the primary level children in their study either as progressing normally or as having language-learning difficulties. That is, auditory discrimination is associated with the development of basic skills that are essential for success in school. The issue is intelligibility, defined as the ability to hear word/sound differences; as distinguished from audibility, the ability to detect the presence or absence of speech. If, due to a mild hearing loss, poor classroom acoustics, and/or poor attention, a child cannot discriminate *vacation* from *invitation*, for example, he or she could not learn semantic distinctions without deliberate support through another sensory system.

Audiologists need to provide fundamental information about hearing and its importance prior to the provision of diagnostic and rehabilitative audiologic recommendations. Such background knowledge cannot be assumed in the school setting (Flexer, Wray, & Ireland, 1989).

Hearing Loss

In an exhaustive literature review, Ross and Calvert (1984) noted that many educational personnel viewed hearing loss as an all-or-none phenomenon; a child is either normally hearing or deaf. Such dichotomous thinking effectively rules out the necessity to consider hearing in programming. That is, if the child is "deaf," then there is not too much that technology can be expected to do relative to enhancing the speech signal. On the other hand, if the child hears normally, why is technology needed? The concept that hearing

loss occurs along a broad continuum needs to be explained as does the concept that very few people have no hearing at all (Ross & Calvert, 1984). The point is that hearing loss cannot be ignored as a variable in academic performance.

School personnel may have difficulty understanding how hearing loss can have such a catastrophic impact on classroom performance. It is helpful to describe hearing loss as an invisible acoustic filter that distorts, smears, or eliminates incoming sounds (Ling, 1986). The negative effects of the hearing loss are apparent; the hearing loss itself is not.

Hearing is the key link in a whole chain of events leading to speaking, reading, and ultimately to academic performance (Ross & Giolas, 1978). Yet, it is not uncommon for a teacher to say, "Of course, Mary has a hearing loss. But, that's not the problem; the problem is that she has such poor reading skills and is so slow in school" (Flexer et al., 1989). The message for school personnel is that the problem *is* hearing loss; the effect is the negative impact of that hearing loss on language and reading skills.

Another concept that has far-reaching implications for classroom performance is distance hearing or earshot, the distance over which speech sounds are intelligible and not merely audible (Ling, 1989, Chapter 3; Ramsdell, 1978). A child with a hearing loss, even a mild or unilateral loss, cannot casually overhear what people are saying or the events that are occurring. Children with normal hearing seem to passively absorb information from their surroundings, while children with hearing loss often seem oblivious to environmental events (Pollack, 1985, Chapter 6). Because of a reduction in earshot, a child with a hearing loss does indeed need to be taught directly many skills that other children learn incidentally (Erber, 1982, Chapter 10).

Without being mindful of distance hearing, a school professional could make the audibility/intelligibility confusions mentioned earlier (Ling, 1989, Chapter 3). A child may appear to respond appropriately, but may be reacting to intonation pattern rather than the words of an utterance. *Go, goes,* and *going* could all sound like "oh" (Bess, 1985; Dobie & Berlin, 1979). An explanation of the difficulties of understanding speech over distances can provide the groundwork for recommending technology to enhance the signal-to-noise ratio (S/N).

SOUND ENHANCEMENT TECHNOLOGY

As Mark Ross has explained, the trouble with having a hearing loss is that one has trouble hearing (Ross & Giolas, 1978). Therefore, the first line of nonmedical intervention is the use of technology to access residual hearing.

Children in school are typically in demanding listening situations due to noise and distance (Berg, 1987, Chapter 7). A limitation of hearing aids is that the microphone is on the wearer who may or may not be close to the talker. The further the microphone is from the sound source, the poorer the S/N. School personnel need to know that, for people with normal hearing, an S/N of +6 dB (speech is twice the sound pressure level of the noise) typically allows for the reception of intelligible speech. Persons with hearing loss need an S/N of +20 dB; speech is 10 times the level of the noise (Finitzo-Hieber & Tillman, 1978). Due to noise, reverberation, and changes in teacher location, the S/N in the average classroom is only +4 dB; less than ideal even for those children with normal hearing (Berg, 1986b).

It can be argued that all children, preschool through college, with any degree of hearing loss, need technology to enhance the S/N (Berg, 1986b; Brackett & Maxon, 1986; Flexer, Wray, Black, & Millin, 1987; Hawkins, 1984). There are three different types of devices

that could be used, depending on the needs of the child and the demands of the particular listening environment. All three enhance the S/N through the use of a remote microphone that can be placed close to the sound source, and all three can be used in addition to personal hearing aids. These devices are personal FM units, sound field amplification, and an inexpensive, hardwire assistive listening device.

Personal FM Units

The most commonly-used device to enhance the S/N is a personal FM system, typically coupled to a child's hearing aids through direct input or a neck loop (Hawkins & Schum, 1985; VanTasell, Mallinger, & Crump, 1986). School personnel may be unfamiliar with the equipment, intimidated by its use, and likely not to use it at the first sign of difficulty (Leavitt, 1987; Woodford, 1987). Audiologists in a proactive role can provide inservice training to school personnel, monitor and troubleshoot equipment, and actively promote its use. Children may otherwise be denied access to this crucial S/N enhancing technology (Berg, 1986b).

Sound Field Amplification

Whereas personal FM units use wireless radio transmission to amplify the teacher's voice for each child who is wearing a receiver, sound field units provide amplification for the entire classroom through the use of two or three wall- or ceiling-mounted loudspeakers (Berg, 1987, Chapter 7). Though all children in the classroom will benefit from an improved S/N of approximately +10 dB no matter where they or the teacher are positioned (Flexer, Millin, & Brown, in press; Worner, 1988), +10 dB may not be enough for some children with more severe hearing losses. They may need to wear a personal FM unit, tuned to the same frequency as the sound field unit, so that the teacher need wear only a single transmitter.

Sound field units show exciting promise for providing children, whether or not they have a hearing loss, with access to intelligible speech (Flexer et al., in press; Ray, Sarff, & Glassford, 1984). A 3-year study of sound field amplification by Osborn, Graves, and Vonder Embse (1989) revealed the following preliminary results: The proportion of students needing special services decreased after 3 years with amplified classrooms. Amplified kindergarten classes scored significantly higher on listening, language, and word analysis tests than children in unamplified classrooms. According to formal classroom observations, students in amplified classrooms had better on-task behaviors than students in unamplified classrooms. Teachers in amplified kindergarten classrooms tended to use less repetition and rephrasing. In amplified classrooms, there were fewer teacher absences due to fatigue and laryngitis, as reported by principals. The study began with 17 sound field units. Three years later, 47 units were in place because teachers wanted them, parents demanded that their children be placed in amplified classrooms, and administrators were convinced of improved pupil performance (Flexer, 1989).

These results are not surprising in view of hearing screening results in the district. When a 15-dB pass-fail criterion was used, 43% of the primary-level students failed on any given day, as did 75% of the primary-level children in a class for the learning disabled. These figures suggest that the incidence and impact of mild hearing loss continues to be underestimated (Northern & Downs, 1984, p. 2). In particular, sound field amplification offers audiologists a nonmedical means to manage children with fluctuating hearing loss.

Inexpensive Hardwire Assistive Listening Device

Even in single-student or small-group instruction, it is often helpful to improve the S/N in order to overcome fluctuating hearing loss, focus the student's attention, and reduce background noise. Such enhancement of the teacher's and pupil's speech can be accomplished by a mild-gain hardwire unit (Sudler & Flexer, 1986), fashioned from inexpensive component parts (Vaughn, Lightfoot, & Gibbs, 1983).

SUMMARY

Neglected issues in educational audiology include inservice training of school personnel about the nature and role of hearing and hearing loss relative to academic performance, and the use of FM technology to enhance the S/N. It is time for audiologists to make their knowledge about hearing, hearing loss, and sound enhancement technology available to school personnel as outlined by federal law. It is time for audiologists to advocate for the necessary right of children to hear clearly.

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