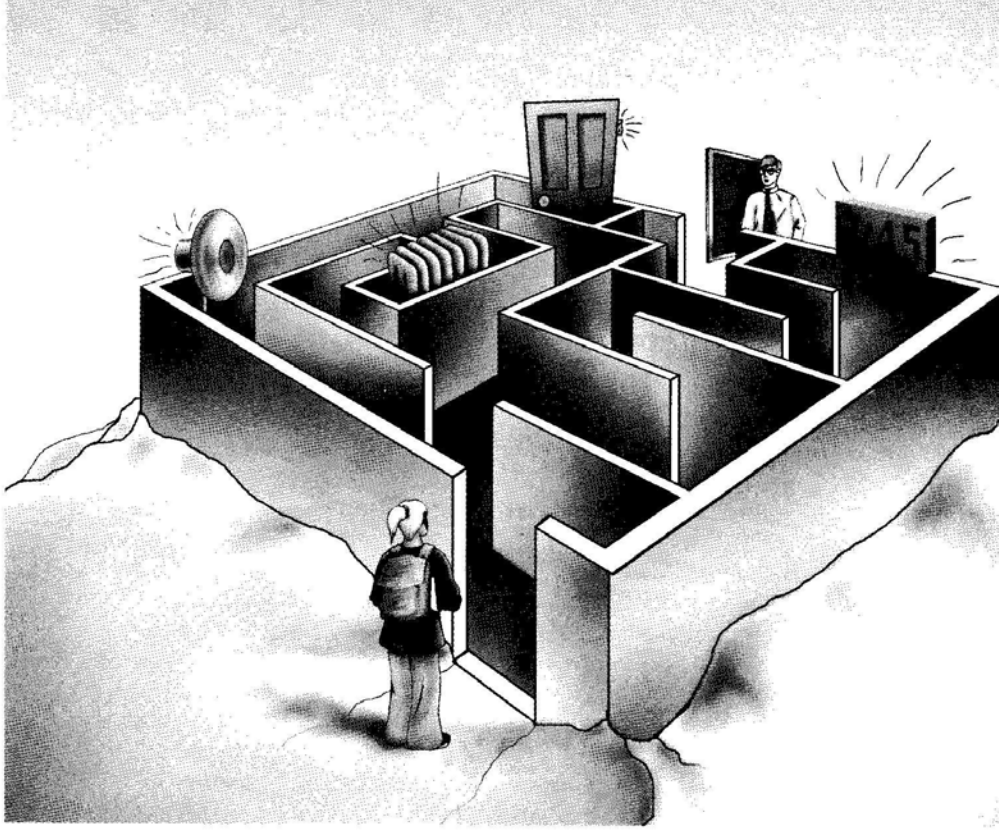
SOUND SOLUTIONS IN THE CLASSROOM

By Abigail Scott



CHILDREN WHO DO NOT HAVE A hearing loss but experience difficulty attending to instruction because of poor classroom acoustics often are missed by audiologists, said Carol Flexer, PhD, CCC-A. As a result, she strongly advocates the modification of classroom acoustics and the use of technology such as sound-field FM systems.

School hearing screening programs typically identify children with middle ear disease or hearing loss resulting from damage to the peripheral hearing system, said Dr. Flexer, a professor in the School of Speech-Language Pathology and Audiology at the University of Akron in Ohio. However, they do not identify children with normal hearing sensitivity who may have difficulty hearing instruction clearly in the presence of typical classroom noise.

"The basic audiological test battery is not designed to identify children's difficulties in hearing classroom instruction in the presence of classroom noise," Dr. Flexer told *ADVANCE*.

One approach for evaluating a child's ability to hear a teacher's instruction in typical classroom noise is to provide word-identification tasks through loudspeakers in the sound-treated room instead of through earphones, she said. "Appropriate speech stimuli should be presented at the average level that speech is received by a child in a very favorable classroom environment," or 45 dB HL.

In the first test condition, the words would be presented in perfect quiet. In the second test condition, the words would be presented in the presence of speech noise at a +5 signal-to-noise (S/N) ratio.

By adding only two speech tests to a basic audiological test battery, an audiologist could provide evidence that a child has a problem with acoustic accessibility of classroom instruction, she stated.

Dr. Flexer also advised audiologists to have teachers fill out questionnaires, such as Fisher's Auditory Problems Checklist, to identify children who have difficulty hearing in the classroom. Tools such as this rate a child's listening ability and behavior in a classroom.

On the Fisher's checklist, for example, the teacher would note whether the child daydreams frequently, has a history of hearing loss, or is distracted easily by background sounds.

Modifying classroom acoustics and utilizing technology help students attend to instruction

"This looks at different behaviors that can trigger our knowledge that a child has difficulty hearing in a classroom," she said.

The acoustics of a classroom play a large role in a child's accessibility to instruction. Classroom acoustics are based on three factors: ambient noise level, reverberation time and S/N ratio.

Open windows or windows not designed to be acoustic barriers increase the ambient noise level of a classroom by letting noise from lawn mowers, street traffic or the playground enter the room. Interior ambient noise may

include other children, computer equipment, heating systems, music and faulty equipment.

Reverberation time—sound echoed off smooth surfaces such as walls or ceilings—increases in rooms with high ceilings, bare floors and walls and reduces a child's ability to hear clearly. Longer reverberation times also reduce the S/N ratio.

Carol Flexer, PhD, CCC-A

According to guidelines set by the American Speech-Language-Hearing Association (ASHA), ambient noise should be no louder than 30-35 dBA in an empty classroom ["March Position Statement and Guidelines for Acoustics in Educational Settings," *Asha*, Vol. 37, (Suppl. 14)]. Reverberation time should not exceed .4 seconds, and S/N ratios should be no lower than +15 dB.

However, Dr. Flexer cited research that showed average unoccupied noise levels in classrooms at 50 dBA, average reverberation times of .52 seconds, and S/N ratios worse than +4 dB ("An Update of Classroom Acoustics for Children with Hearing Impairment," *The Volta Review*, Vol. 96).

Audiologists can use sound-level meters to measure acoustics in several spots in the classroom and under a variety of conditions. They can measure the levels of ambient noise in unamplified and amplified classrooms.

They also can compare the sound-level meter readings of an unoccupied classroom to one that is occupied.

If audiologists find a classroom to have too much ambient noise or reverberation times that are too high, they can instruct educators on strategies to improve the acoustic environment for learning.

To reduce ambient noise and reverberation time, she recommends the use of acoustical ceiling tile, carpeting, rubber tips on chair and table legs, and thick curtains (*Auditory Disorders in School Children*, New York: Thieme Medical Publishers, 1995, and *Sound-Field FM Amplification: Theory and Practical Applications*, San Diego, CA: Singular Publishing Group, 1995).

Proper maintenance of lighting and ventilation systems, doors and windows also serves to reduce excess noise in the classroom. Teachers should try to instruct children in areas away from noisy equipment such as air conditioners and computers.

Audiologists can offer inservice programs for teachers to point out how important access to sound is for learning. "A lot of teachers need to realize that hearing and listening are first-order events for the development of language and reading," Dr. Flexer reported. "They need to understand how critical hearing is, and they should emphasize it as part of their instructional strategy."

Dr. Flexer strongly recommends the use of sound-field FM systems for special education classrooms, typical classrooms, and those that mainstream students with hearing impairment. She hopes to see most classrooms in the United States using sound-field FM systems by the year 2005.

"The goal with sound-field FM is to get the same positive S/N ratio throughout the classroom so there is no disadvantaged position," she said.

Sound-field systems can improve a child's learning environment and learning potential.

Children in typical classrooms who have difficulty attending or processing information would benefit from sound-field FM systems. The heightened ability to distinguish among words and sounds from an FM system would contribute to future academic success.

"There are a lot of audible sounds, but children need to hear well enough to distinguish phonemes and hear speech intelligibly," Dr. Flexer said. "To distinguish between sounds, you have to hear the consonants as well as the vowels."

The clearer signal provided by an FM system would allow children who are learning English as a second language to better differentiate between the syllables, grammatical markers and sounds of the new language.

Preschools, kindergartens, and classrooms for grades 1-3 especially would benefit from FM systems because many kindergarteners and first graders tend not to be able to hear speech clearly on any given day due to intermittent middle ear dysfunction.

Children with normal peripheral hearing sensitivity who are in special education classrooms because of language, learning or attentional problems may benefit from sound-field FM systems.

Teachers can use sound-field FM systems, such as the ClassMate™ Sound Field Amplification System by Telex Communications, Inc., Minneapolis, MN, to improve classroom listening skills. *(photo/courtesy Telex Communications, Inc.)*

Personal FM systems may be of more benefit than sound-field systems to children with severe to profound hearing loss, or with severe central auditory processing disorders who need a better S/N ratio, she observed. Low-gain, low-power output personal FM systems also may benefit children with unilateral hearing impairment, language delays and attention problems.

• *For more information, contact Carol Flexer, PhD, School of Speech-Language Pathology and Audiology, University of Akron, Akron, OH 44325-3001.*

Abigail Scott is assistant editor of ADVANCE.

Modifications to Improve Classroom Acoustics

- **Acoustical ceiling tiles.**
- **Carpeting.**
- **Thick curtains.**
- **Rubber tips on chair and table legs.**
- **Proper maintenance of ventilation systems, lighting, doors and windows.**