

Providing Audiology Services to School Children More Than Just Preferential Seating

By Karen L. Anderson, PhD & Joseph J. Smaldino, PhD

Providing audiology services to school-aged children is difficult without a thorough understanding of how they receive and use speech acoustics in everyday environments, particularly the classroom. Fitting amplification to meet a child's prescriptive formula targets is important, but this is only part of the audiologist's role.

Defining and understanding a student's ability to access verbal instruction is a critical component, as is recognizing how access to instruction is affected. Audiologists must be aware of a child's ability to perceive elements of speech through a personal amplification device, his speech perception of classroom communication, his performance in the classroom in various listening situations, and his strategies for self-advocacy when he does not completely understand.

Gone are the days when it was sufficient for an audiologist to recommend "preferential seating" as a primary intervention. School districts are more aware of the need for assistive hearing devices for children and for hearing impaired students to have language performance commensurate with normal hearing peers. While this language performance is a hallmark of the efforts to identify hearing loss and to intervene earlier, improvements in language performance often lead to a denial of special education support, including hearing assistive technology.

Because of these changes in how hearing impaired children are perceived and their eligibility for support services, it is critical for the audiologist not only to identify and treat the hearing loss, but also to develop a picture of the student's ability to access verbal instruction. That can then be used to provide recommendations for technology, accommodations, and skill development based on the gathered information.

PERSONAL AMPLIFICATION DEVICES

Not every student's hearing loss can be matched precisely to prescription targets to result in full perception of the speech spectrum. It is important to provide a brief description of just how well the child's amplification device will allow him to perceive speech in an environment where the speech level is

dynamically changing. Even a very close match to prescription target still means that some elements of speech will be beyond the student's capability to perceive.

In a dynamic classroom setting, every decibel counts. School staff must meet the student's needs if there are any foundational deficiencies in audibility of speech. It may be easier to identify deficiencies by plotting a Speech Audibility Audiogram for Classroom Listening. (*Hear Rev* 2011;18[10]:20; *Building Skills for Success in the Fast-Paced Classroom*. Hillsboro, OR: Butte Publications, 2011.)

Based on the Count the Dots Audiogram, this test allows the professional to better estimate listening under varying speech loudness conditions present in a typical classroom.

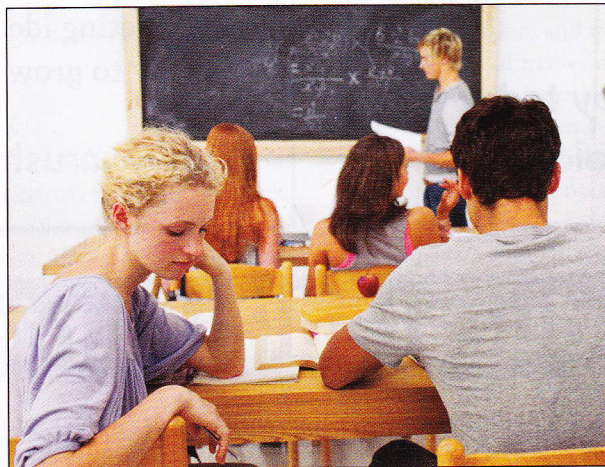
SPEECH PERCEPTION

Ideally, functional listening measures will be performed in the student's actual classroom using typical desk-to-front distance (near) and desk-to-back distances (far). This may be dif-

ficult to arrange, even for audiologists employed by a school district. Performing a Functional Listening Evaluation (FLE) has long been a staple in educational audiology, and it consists of a series of speech recognition tasks using calibrated signals. (*Educational Audiology Handbook*. Florence, KY: Cengage Learning, 2011.) (See FastLinks for instructions on how to perform an FLE.)

The audiologist should at least perform listening-in-noise assessments in a clinical environment. It is suggested that a 35 dB HL input be used to represent soft speech (such as peer responses from across the classroom or quiet speech of peers), and at least a 50 dB HL input be used to represent teacher speech. Teachers often speak more loudly than this (60 dB HL), but the dynamic nature of talking throughout the day and from varying distances results in situations in which a student must be able to perceive teacher speech at 50 dB HL to access verbal instruction.

Choice of noise level should be +5 S/N unless the student describes the classroom as being well treated acoustically (carpeting, ceiling tile, and good control over student noise). Students vary in their individual use of speechreading and how



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SPEECH AUDIBILITY AUDIOGRAM FOR CLASSROOM LISTENING

	Student _____	Grade _____	School _____	Date _____		
Loudness in dB HL	250	500	1000	2000	4000	8000 Hz
	Soft speech (35 dB HL)			Teacher voice (50 dB HL)		
	Typical hearing children: 93-98% word recognition in quiet 86-94% at 35 dB HL in 0 S/N noise ¹ .			Typical hearing children: 92-100% word recognition at 50 dB HL in quiet, 90-97% in +5 S/N, and 89-96% in 0 S/N noise ¹ .		
0	95% audibility of speech energy perceived with hearing levels between 0 – 10 dB HL 64% at +10 S/N, 34% at 0 S/N⁶			0-20 dB HL should perceive 98% of speech sounds at a comfortable level in a quiet classroom and acceptable reverberation levels (35 dBA or less background noise in an unoccupied classroom & reverberation no greater than 0.9 sec ⁴) 84% at +10 S/N, 48% at 0 S/N		
10	75% audibility of speech energy perceived with hearing levels between 10 – 15 dB HL 44% at +10 S/N, 24% at 0 S/N					
15	60% audibility of speech energy perceived with hearing levels between 15 – 20 dB HL 29% at +10 S/N, 9% at 0 S/N					
20	40% audibility of speech energy perceived with hearing levels between 20 – 25 dB HL 9% at +10 S/N, 0% at 0 S/N			95% audibility of speech energy perceived with hearing levels between 20 – 25 dB HL 81% at +10 S/N, 55% at 0 S/N		
25	25% audibility of speech energy perceived with hearing levels between 25 – 30 dB HL 0% in any setting that is not quiet			81% audibility of speech energy perceived with hearing levels between 25-30 dB HL 67% at +10 S/N, 41% at 0 S/N		
30	15% audibility of speech energy perceived with hearing levels between 30 – 35 dB HL 0% in any setting that is not quiet			60% audibility of speech energy perceived with hearing levels between 30-35 dB HL 46% at +10 S/N, 20% at 0 S/N		
35	10% audibility of speech energy perceived with hearing levels between 35 – 40 dB HL 0% in any setting that is not quiet			45% audibility of speech energy perceived with hearing levels between 35 – 40 dB HL 31% at +10 S/N, 5% at 0 S/N		
40				30% audibility of speech energy perceived with hearing levels between 40 - 45dB HL 16% at +10 S/N, 0% at 0 S/N		
45						

S/N means the loudness of the speaker's voice (i.e. teacher) over the background noise. 0 S/N means the noise and voice are the same loudness. +10 means that there is noise but the teacher's voice is 10 dB louder. Use of FM is necessary to negate the effects of background noise and to provide optimal access to verbal instruction when used in large and small group listening.

Results of Functional Listening Evaluation: Type of speech materials used:

SPEECH PERCEPTION	Close / Quiet	Close / Noise	Distant/Quiet	Distant/Noise
Auditory + Visual				
Auditory Only				

Close = _____ Feet
 Distant = _____ Feet
 Quiet = _____ S/N*
 Noise = _____ S/N*
 *at child's ear level

Audibility represents the listening challenge, or fragmented speech perception, experienced by listeners with hearing loss. Audibility should not be interpreted as speech perception.

AUDIBILITY	Quiet No noise	+10 dB S/N Good classroom listening condition	0 dB S/N Very noisy classroom listening condition
Estimated Audibility Soft Speech			
Estimated Audibility Teacher's Speech			

Recommended Hearing Technology/Accommodations:

1. Budkin, N., Madell, J., & Rosenfeld, R. (1999). Word recognition in quiet and noise for normally developing children. AAA Convention, Miami, Poster Session.
 2. Kilian, M. & Mueller, G. (2010). *Tenets years later a new count the dots method*. *The Hearing Journal*, 63(1), 10, 12-14, 16-17.
 3. Miller GA, Heise GA, Lichten W (1951). The intelligibility of speech as a function of the context of the text materials. *J Exp Psychol* 41(5):329-335.
 4. Yang, W., & Bradley, J. S. (2009). Effects of room acoustics on the intelligibility of speech in classrooms for young children. *J Acous. Soc. Am.*, 125(2), 922-933.
 5. Revised 2004 by Johnson. Based on *Functional Listening Evaluation* by C.D. Johnson & P. Von Almen, 1993.
 6. Nelson, P., Anderson, E., Nie, Y., Katsare, B. (2010). Effect of reduced audibility on masking release for normal- and hard-of-hearing listeners. *JASA* 127, 1903.

much benefit speechreading provides to understanding. It is important to obtain estimates of speech perception under auditory-plus-visual and auditory-only conditions. These results can be included on the Speech Audibility Audiogram for Classroom Listening to provide an estimate of student speech perception in the classroom that is highly relevant to school staff. (*Hear Rev* 2011;18[10]:20).

THE ACOUSTIC ENVIRONMENT

Audiologists in schools frequently estimate the background noise and reverberation levels present in a student's classroom environment. The advent of various smart phone applications makes estimating these relatively fast, reliable, and inexpensive.

Comparing a student's current classroom acoustic setting to ANSI S12.60-2010 standards for classroom environments

is an important part of determining an appropriate learning environment for the student with hearing loss. The most recent version of the standard specifies that the listening environment should be appropriate to the needs of the student with hearing loss, implying that his needs will be more stringent than those of the standard in general.

ESTIMATING SPEECH PERCEPTION

Estimating speech perception under different conditions provides a relatively objective measure of performance. School personnel often wonder how these percentages reflect a student's ability to understand verbal instruction, which is a valid and important question. A student self-rating can be performed to determine this. Children are typically mature enough to provide accurate self-ratings at about age 8.

Educational audiologists have used and highly regarded the Listening Inventory for Education (LIFE) for more than 10 years. We, along with Carrie Spangler, have recently developed the Listening Inventory for Education-Revised (LIFE-R). (Available for free download; see FastLinks.)

The Student LIFE-R includes Before LIFE Questions, a set of six multiple choice queries that allow the student to describe his classroom listening setting. The answers provide valuable information that can inform the audiologist on S/N choices to use during performance of the FLE. This get-set activity also prepares the student to accurately represent and be aware of his listening challenges.

The Student LIFE-R provides 15 updated school listening situations — 10 classroom listening questions and five additional questions about other school listening situations. It also includes a table that the student fills out with the audiologist based on how he responded to the school listening situation questions, resulting in a list of his most challenging listening situations that can be shared with school staff and parents.

This information and the FLE results will assist the audiologist in determining what accommodations and technology are needed by the student. The audiologist can also request the teacher take a LIFE-R as a validation measure of benefit of changes in hearing assistance technology. The Student LIFE-R will be developed into an interactive electronic format with pictures later this year.

STUDENT SELF-ADVOCACY

Even with the most recent amplification and FM technology in use, the student with hearing loss will still miss some verbal communication in the classroom. It is not uncommon for FM transmitters to fail to be passed around during class discussions or used during small-group learning activities. Even when FM devices are used appropriately, the student with hearing loss is still more likely to miss verbal information than students without hearing loss because of imperfect auditory access, vocabulary deficiencies, and listening fatigue.

A form of access to verbal instruction often overlooked is what the student does when he realizes that he missed critical information. Audiologists in pediatric or educational settings

often have the advantage of working with a child and family from diagnosis through childhood, and empowering the child to advocate for himself should be a subtext of almost every conversation the audiologist has with the child and family.

At approximately age 3, the audiologist can request that the family complete the Children's Home Inventory of Listening Difficulties (CHILD) to heighten their awareness of their child's listening challenges and as a basis for discussions on shaping self-advocacy strategies. This information is highly relevant when a child is transitioning to school at age 3 or 5 or when a student is moving to a new school and up to age 12. The Starting School LIFE encourages team discussions during transition and uses the family's responses from the CHILD and other questions to inform the school team on listening challenges.

The Student LIFE-R also has After LIFE questions that provide a new type of assessment of student function. Six multiple choice questions ask the student how he responds when he doesn't hear or understand what was said. The purpose is to briefly identify the level of self-advocacy skills that the student uses. The responses can shape recommendations from the audiologist that can be addressed in IEP goal development.

The multiple choice questions in Before LIFE and After LIFE could be administered to students younger than 8 depending on their linguistic development and relative maturity. The revision of the Teacher LIFE-R now includes a second page: Teacher Checklist: Self-Advocacy and Instructional Access, on which the teacher answers eight questions that describe different self-advocacy activities. Taken together with the Student LIFE-R and Student After LIFE Questions, the audiologist can identify student self-advocacy needs and track progress over time.

The Student LIFE-R, Teacher LIFE-R, and the Starting School LIFE with the family response portion of the CHILD can be downloaded without cost. (See FastLinks.)



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FastLinks

- Download the Listening Inventory for Education-Revised (LIFE-R) at <http://bit.ly/z6e2mX>.
- Find the Children's Home Inventory of Listening Difficulties (CHILD) at <http://bit.ly/zZWCXN>.
- Instructions for performing a Functional Listening Evaluation are available at <http://bit.ly/xGOgx1>.
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