Perspectives on Hearing and Hearing Disorders in Childhood
Volume 25, April 2015, Copyright © 2015 American Speech-Language-Hearing Association

Access is the Issue, Not Hearing Loss: New Policy Clarification Requires Schools to Ensure Effective Communication Access

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Disclosures: Financial: Karen L. Anderson has no relevant financial interests to disclose.
Non-financial: Karen L. Anderson is the Director of Supporting Success for Children with Hearing Loss.

Abstract

Communication access is a key component of 504, IDEA and Title II of the Americans with Disabilities Act (ADA). A November 2014 policy guidance from the U.S. Department of Education and U.S. Department of Justice clarified that, under Title II of the ADA, schools are required to ensure that students with disabilities receive communication with others through the provision of appropriate auxiliary aids and services. In other words, they are responsible for ensuring that communication access is as effective for children with hearing loss as it is for their typically hearing peers. Hearing loss is invisible and the impact is often mistaken for a learning disorder rather than performance issues secondary to decreased access to communication. Information in this article is presented to assist the educational audiologist, teacher of the deaf/ hard of hearing, or speech-language pathologist in demonstrating the impact of hearing loss on access to classroom communication so that the question "Does this student have effective access to communication in school?" can be answered in an evidence-based manner.

In 1999, the United States Access Board, which develops guidelines for accessibility under the Americans with Disabilities Act (ADA), published a notice in which they emphasized that a noisy and reverberant classroom is as much a barrier to children with hearing loss as stairs are to those who use wheelchairs (Architectural and Transportation Barriers Compliance Board, 1999). After almost a decade of study and deliberation, American National Standards Institute (ANSI) Standard S12.60 was developed, defining acceptable levels of background noise and reverberation in U.S. classrooms (ANSI, 2010).

A November 2014 policy guidance from the U.S. Department of Education and U.S. Department of Justice clarified that, under Title II of the ADA, schools are required to ensure that students with disabilities receive communication with others through the provision of appropriate auxiliary aids and services (United States Departments of Education and Justice, 2014b). Public schools must provide appropriate "auxiliary aids and services" where necessary to provide effective communication so that students with disabilities have an equal opportunity to participate in, and enjoy the benefits of, the services, programs, and activities of the public school district. In general, the services, devices, technologies and methods for providing effective communication that are "auxiliary aids and services" under Title II could also be provided under the Individuals with Disabilities Education Act (IDEA) as part of free appropriate public education (FAPE). Examples of auxiliary aids provides for persons who are deaf, deaf-blind, or hard of hearing specified in the Title II Frequently Asked Questions (United States Departments of Education and Justice, 2014a) are:

- Note-takers
- Exchange of written materials

- Real-time computer-aided transcription services (i.e., Communication Access Real-Time Translation [CART])
- Assistive listening systems
- Accessible electronic and information technology
- Open and closed captioning
- Interpreters

Examples of services specified in IDEA as part of Supplementary Aids and Services are:

- Training for staff, student, and/or parents
- Collaboration/consultation among staff, parents, and/or other professionals

When the school district knows that a student needs assistance with communication because, for example, he or she has a hearing, vision, or speech disability, the school district has an affirmative obligation to provide effective communication under Title II, whether or not a parent requests specific auxiliary aids and services under Title II and regardless of whether the student has an IEP, 504 Plan, or is considered to be ineligible for these services and supports. Parents need to be informed of these rights. If the student has indicated a need for an auxiliary aid or service or requested a particular auxiliary aid or service, the public school district must provide it, or the alternative, as soon as possible. Under Title II, the public school has a continuing obligation to assess the auxiliary aids and services it is providing to students with hearing, vision, or speech disabilities to ensure that these students are receiving effective communication, with a strong emphasis on reassessing access needs as changes in situation arise. Further, although Title II does not designate a particular responsible person, the school district could designate an ADA Coordinator to facilitate the process (United States Departments of Education and Justice, 2014a).

The presence of national standards for classroom acoustics in combination with the requirement for effective communication in school for children with hearing loss has resulted in an urgent need for persons who specialize in supporting children with hearing loss to know how to identify the *level* of communication effectiveness for each student performing in her or her individual classroom(s). Standard audiograms and evaluation information gathered by an audiologist in a sound-treated environment will not provide this information as the issue is not hearing loss per se as much as it is individual functional performance in the classroom setting. Communication effectiveness will change with classroom acoustics (noise, reverberation), activity (distance, vocabulary, interaction dynamics), and speech perception (degree to which communication is fragmented from hearing loss, precision of amplification fitting, use of hearing assistance technology). Therefore, the professional specializing in supporting children with hearing loss needs to look beyond standard audiometric, academic performance and language ability compared to norms in order to provide information on a student's ability to effectively process speech information in the classroom. Areas to consider include:

- Fragmented hearing, including the effect of the school communication environment
- Effort
- Listening Comprehension
- Fatigue
- Pace of Learning
- Auxiliary aids and services to improve effectiveness of school communication

Areas to Consider

Fragmented Hearing

The use of the term fragmented hearing refers to the impact that hearing loss has on the complete perception of speech. Due to the hearing loss, speech perception is fragmented, meaning the student has challenges perceiving phonemes due to inaudible regions of hearing and/or hearing loss in combination with the impact of noise or reverberation in the environment that further fragments the auditory signal that the student is able to perceive. The results of a Canadian Language and Literacy Research Network study (Bradley, 2005) found that in typical classroom conditions where the students are attentively listening to a teacher, about 75% of Grade 1 students will not understand 1 in 6 simple, clearly spoken words and about 25% of Grade 1 students will not understand 1 in 5 words. This is true for the average conditions found in typical good classrooms. Of course, many classroom designs have less appropriate acoustics resulting in students understanding even less of the teacher's speech. Although older students are better able to understand speech in noise, the typical level of noise found in classrooms clearly interferes with the learning process, making it more difficult for students to learn new information. This increased difficulty is further exaggerated for certain groups of students such as those with hearing loss.

Is the acoustic environment appropriate? Any consideration of effective school communication for a child with hearing loss must start with the acoustic environment. Classrooms are typically noisy with noise levels potentially exceeding recommended standards by up to 30 dB, even in unoccupied classrooms (Crandell & Smaldino, 2000; Knecht, Nelson, Whitelaw, & Feth, 2002). Never before has it been as easy to estimate the background noise level and/or reverberation level in a classroom. Readily available smartphone applications (apps) for acoustical measurement can be used to obtain estimated noise and reverberation levels (Ostergren & Smaldino, 2012). It is suggested that this information be collected via the Classroom Acoustical Survey Worksheet (Smaldino & Ostergren, 2012). The results can then be compared to the national classroom acoustic standards of a minimum of 35 dBA background noise in unoccupied classrooms and 0.6 second reverberation in a standard-sized classroom. Furthermore, the signal-to-noise ratio during verbal instruction can be estimated and compared to +15 S/N, which is necessary for all phonemes to be perceived above the level of noise. As the national classroom acoustic standards were developed primarily for children with typical hearing, they can truly be considered a *minimum* for children with hearing loss. As effective communication specifically includes interactions with peers and fully perceiving comments during class discussions by peers, it cannot be assumed that use of hearing assistance technology (i.e., frequency modulation system) fulfills the requirement for ensuring communication effectiveness.

Persons with hearing loss do not perform as well as those with typical hearing under all conditions of reverberation and background noise (Finitzo-Hieber & Tillman, 1978; Irwin & McAuley, 1987; Nabelek & Pickett, 1974a, 1974b). This has been reported as possibly being due to perceiving speech in a fragmented manner that affects the ability to follow the changes in the temporal envelope of an acoustic wave form with the accuracy of listeners with typical hearing (Irwin & McAuley, 1987). If communication access is the concern, then it is appropriate to investigate just how well a student is able to perceive speech under varying conditions.

Has the use of hearing technology maximized perception of speech sounds? Performance of aided audiograms was a common practice when all children were wearing analog hearing aids, however, this practice fell to the wayside as Desired Sensation Level (DSL) targeting procedures became the preferred best practice for clinical audiologists. Although the DSL results are appropriate when optimizing hearing aid fitting, they do not provide much useable information for discussions with school teams. Performing aided audiograms is becoming more prevalent again, with aided hearing thresholds being performed in a sound booth using narrow band noise stimuli. Optimally, a child will be able to detect noise in a narrow band range as close to 20 dB HL as possible if we are to expect him or her to perceive speech optimally in a classroom. It must be kept in mind that an optimal hearing fitting, even with aided thresholds of 20 dB HL, is still not providing the child with the same level of speech perception as a typical child.

Two more functional assessments of speech perception are suggested assess how well a typically developing student is able to perform fine auditory discrimination. The Wepman Auditory Discrimination Test (Wepman & Reynolds, 1987) was standardized on a stratified national sample of 2000 children ages 4–8 and requires the child to state whether word pairs contain two of the same words or two different words. Results of this assessment can reflect whether the student is able to discriminate speech sounds as effectively as age peers, or, if the student is older than age 8, if they are able to perform optimally on the test as would a typically developing child over the age of 8 years. Another option for an informal assessment is the Iowa Medial Consonant Test (Tyler, Preece, & Lowder, 1983). For this task, the tester presents a list of consonant sounds and asks the child to repeat them. Either a-a or e-e can be used (i.e., ata, apa, asha or eke, eve, eme). Each consonant is repeated more than once within the list. A presentation distance from 3 feet and 10 feet is used, without any visual cues. If a child uses appropriately set hearing aids full time and has had intervention to develop auditory skills, then excellent speech perception (100%) could be expected, especially at a 3 foot distance. This assumes that a child is a cochlear implant user or has a mild to moderate hearing loss (26–70 dB HL). If a child who is primarily an auditory learner is not achieving 100% under these conditions, then the hearing aid fitting can be questioned and auditory skill performance further assessed.

What is the size of the student's "listening gap" under varying conditions? Even aided hearing thresholds of 20 dB HL will often cause soft speech, high pitch speech sounds, and unemphasized brief words to be undetected or too quiet to cognitively process. The Functional Listening Evaluation (Johnson & Von Almen, 1997) requires the student to repeat stimuli under 8 conditions: 3 feet/12 feet and in quiet/noise, each while watching/not watching (access to speechreading cues). Single words, common phrases, nonsense stimuli, or sentences can be used. Designed to be performed with the student in his or her otherwise unoccupied classroom, the Functional Listening Evaluation can also be performed at other relatively quiet locations within the school. As an alternative, the Functional Listening Evaluation can be performed as part of the audiological evaluation, preferably using 35 dB and 50 dB speech inputs with +5 S/N so that results can be compared to that of typically hearing age peers tested at these levels with a resulting average performance at 90% or better, even under the most challenging listening conditions (Bodkin, Madell, & Rosenfeld, 1999).

The results of the Functional Listening Evaluation provide an estimate of the student's level of effectiveness for perceiving speech at different classroom distances and under different levels of background noise. As an estimate, it can be considered good practice to use sentence stimuli because listening for connected speech and taking advantage of its redundant characteristics is much more similar to classroom listening tasks than single words or phrases. The Title II clarification specifies that a student's ability to access peer-to-peer communication or class discussions be considered. If the student is unable to perform at 90% or better while listening to soft speech (12 feet) without visual cues in quiet and noise, then there is a "listening gap" or communication access issue.

Effort

Effort refers to the exertion of physical or mental power. Listening effort refers to the attention necessary to understand speech. In a critical review of controlled classroom studies, Hartman considered collected articles from the 1930s. A summary of the findings indicated that high levels of background noise were likely to be most disturbing when a student was engaged in tasks that demand higher mental processes. Hartman stated, "The efficiency of all kinds of mental work, especially the more complex varieties is generally noticeably lowered" and further noted that, "able or highly motivated pupils maintain approximately the same level of achievement [. . .] by virtue of putting forth additional effort to overcome the new obstacles" (Hartman, 1946, p. 161).

Effort refers to the exertion of physical or mental power. Listening effort refers to the attention necessary to understand speech. Research on persons with typical hearing (Fraser, Gagné, Alepins, & Dubois, 2010; Howard, Munro, & Plack, 2010; Picou, Ricketts, & Hornsby, 2011) found that considerable listening effort is required when listening at noise levels typical of the school classroom. In low noise, being able to watch the speaker improves speech understanding and reduces listening effort. Listening in high noise while watching the speaker results in greater effort to understand speech. Listeners who are better speechreaders benefit more from visual cues than those that are poor speechreaders.

Processing visual cues in addition to listening requires more cognitive resources. Listeners with sufficient cognitive resources (i.e., working memory capacity) can make use of speechreading to increase understanding. Without enough processing capacity, listening effort increases and speech recognition is slower when a child is both listening and watching the speaker. Based on the results of this research (Fraser et al., 2010; Howard et al., 2010; Picou et al., 2011), we can assume that children with hearing loss work harder to listen and use more cognitive resources to understand speech in the classroom as compared to class peers because even low noise in the environment will interact with the fragmented hearing to interfere with their speech perception. It has been assumed by many educators that speechreading will help children to compensate for what is missed due to fragmented hearing. These research results make it clear that this is only true IF a child is a good speechreader AND he or she has typical or better working memory capacity.

Memory is a window into the impact of effort on cognitive resources needed for processing. Working memory allows us time to rehearse the material or to perform some other mental operations on the material. As far back as 1912 (Winch, 1912), research indicated that school children are more fatigued in the afternoon than in the morning, with 5–6% of students in the morning showing signs of significant fatigue and up to one-third of the class being significantly fatigued in the afternoon, as measured by tests of immediate memory. Those children who were significantly fatigued had a hard time staying on task and showed a steady decline in their work. More modern working memory research (Beaman & Roer, 2009) found that noise impacts both long- and short-term memory for children. Boudreau and Costanza-Smith (2011) note that working memory impacts a vast quantity of cognitive processes, individual learning rate for new vocabulary, language comprehension, literacy skills, reasoning, and problem solving, as well as overall academic success. Further, working memory controls attention and information processing. Therefore, it is important to assess speechreading ability (i.e., Functional Listening Evaluation) and the memory capacity (in quiet and noise) of students with hearing loss. One option for doing so would be via the Test of Auditory Processing Skills–3 (TAPS-3; Martin & Brownell, 2005), which investigates aspects of working memory skills.

Will improved technology improve performance? Research (Sarampalis, Kalluri, Edwards, & Hafter, 2009) found that extracting speech in the presence of high levels of background noise reduces the listener's ability to mentally rehearse material that was heard so it could be remembered. In theory, use of hearing technology with a noise reduction algorithm can free up cognitive resources that would otherwise be involved in extracting speech from noise. When typically hearing children and children with hearing loss using hearing technology with noise reduction algorithms were compared (Pittman, 2011), it was found that if the child with hearing loss was required to do any competing task that there was no improvement using the noise reduction technology. When so many cognitive resources are expended for listening, there is little capacity left to perform other tasks (i.e., notetaking, looking at class visuals) and digital noise reduction appears to not improve this ability. If a child has a higher cognitive aptitude, then managing listening plus other tasks would be more likely. Therefore, digital noise reduction technology at this point may not provide improvement in typical classroom listening situations. It *may*, however, improve performance in very noisy conditions such as a child listening in a simultaneous small group cooperative learning situations, a noisy lunch room, or busy hallway passing times at school, as long as the only expectation is listening.

Listening Comprehension

Within education, it is a basic assumption that when the teacher is speaking, the students will, in general, comprehend what they have heard. Listening comprehension abilities of children with hearing loss are typically lower than those of children with normal hearing due to the effort used to listen, which decreases the cognitive resources available to understand what was heard.

A study of typically developing children's ability to follow instructions found that children perform better in noise than in noise plus reverberation. Noise plus reverberation worked together to impact the processing of listening to directions, even when students could see the face of the speaker (Lewis, Manninen, Valente, & Smith, 2014). Smearing of the speech signal from a single person talking was no better than if multiple people were talking. This 2014 study revealed that when reverberation in the environment is at 0.6 seconds (which meets national classroom acoustics standards) or worse, it is likely impacting higher level cognitive processes as the children with normal hearing try to understand the teacher, class discussions, or peer-to-peer communication. It has long been recognized that children with hearing loss are even more sensitive to the impact of noise and reverberation in the environment (Finitzo-Hieber & Tillman, 1978). Unless the acoustic conditions of the classroom are considered, it is likely that the learning environment will be impacting the ability of the child with hearing loss to follow directions. A simple following directions task in quiet, in noise, and with the use of assistive hearing technology can provide an estimate of the potential impact of classroom acoustics on this ability. Examples of acoustic considerations to reduce reverberation include canting the angle of white boards by placing three inch blocks along the bottom so that sound is reflected into acoustic ceiling tile or adhering sound absorbtion panels to the upper third of two adjoining walls, and considerations to reduce background noise include installing carpeting or using a damping product such as Hush-Ups that are similar to tennis balls on the bottom of each chair and desk leg.

What is the student's "gap" for listening comprehension of typical classroom communication? The Listening Comprehension Test 2 (Bowers, Huisingh, & LoGiudice, 2006) identifies skills in five areas, comparing the student tested to a norm group of typically hearing and typically developing children of the same age. One research study used this test to assess a group of children with typical hearing when they were listening in noise (Schafer et al., 2013). It was found that excessive noise affects cognitive processing of information, even for children with typical hearing. Children had the greatest difficulty on the details, reasoning, and understanding messages subtests. Identifying the main idea was resilient to interference from noise because the redundancy of language throughout the story informs the participant about the main idea. Defining vocabulary, especially unknown vocabulary, is dependent upon hearing the unknown word within the context of the story. At least half of these typically hearing children had significant difficulty defining vocabulary. The greatest impact was on the subtests requiring higher-order comprehension, with younger children performing more poorly than older children. Detail recall was impacted due to inaudibility of the entire passage and/or possible reduced short-term memory when listening in background noise. The reasoning subtest requires students to generate inferences and conclusions based on what they heard in the story. If details were missed or not remembered, the reasoning subtest would be very impacted. Finally, the understanding messages subtest requires the child to repeat important information heard during the story; another skill that is impacted by listening in noise. Due to fragmented hearing and extra listening effort, children with hearing loss are already more vulnerable than their peers to missing and comprehending information—with or without excess noise—even if they have age-appropriate language. Performing assessments such as those included in the Listening Comprehension Test 2 or the Listening Comprehension Test Adolescent will provide valuable information about how effectively the student with hearing loss comprehends what he or she heard. Using an FM while doing this test will provide the student's best possible listening comprehension performance on these higher cognitive tasks.

How much is the student understanding classroom discussion? Another study had typically hearing students answer comprehension questions about a story presented in two ways (Valente, Plevinsky, Franco, Heinrichs-Graham, & Lewis, 2012). The story was either presented in a lecture format or the parts of the story were presented from locations surrounding the student, to simulate listening to classroom discussion. The first finding was that accuracy when repeating sentences in quiet or noise (like on a Functional Listening Evaluation) does not predict the true impact of classroom acoustics on listening comprehension for lecture or discussion. For example, children who would achieve a 95% accuracy repeating sentences in a typical classroom listening environment (+7 S/N noise, 0.6s reverberation) would perform more poorly under more typical listening activities. Specifically, average results for 11-year-olds when listening to lecture were 80% accurate and 75% accurate for discussion, whereas for 8-year-olds they were 40% and 33% respectively. If the noise level was reduced (+10 S/N) the scores for understanding discussion improved from 75% to 90% for 11-year-olds and from 33% to 60% for 8-year-olds respectively for children with typical hearing. When considering effective communication in the classroom, it is important to not assume that the ability to understand lecture well infers that the student will also be able to understand class discussion well.

How much is the student utilizing speechreading? When? How effectively? As previously stated, students with hearing loss are more greatly impacted by noise and reverberation than their typically hearing peers, which is why provision of hearing assistive technology is so widespread. Even though hearing assistance technology like an FM system will optimize listening to a lecture in the presence of excessive noise and reverberation, only a good acoustic classroom environment will allow the student with hearing loss to access classroom discussion. The Valente et al. study further found that the younger participants (age 8) looked around more to aid their understanding during discussion. The surprising result was that they typically were unable to visually keep up as the discussion moved from student to student. Furthermore, it appeared as though the act of trying to visually track class discussions actually used up more cognitive resources, resulting in reduced comprehension, especially for younger students. Thus, as discussed in a previous section of this article, the concept that a student with hearing loss can compensate for ineffective communication in the classroom by focusing more on speechreading the teacher and peers is erroneous and may instead cause the student to expend greater effort at the cost of comprehension.

Fatigue From Listening/Processing

Fatigue refers to the weariness resulting from exertion. Mental fatigue relates to one's ability to attend or concentrate and refers to a general feeling of being tired. Nagane (2004) used a self-report measure to assess fatigue in fourth-grade students recruited from typical classrooms. Children reporting higher levels of fatigue were less active in school and performed more poorly on standardized reading comprehension and math tests. Thus, a fatigued child is a child who potentially is not learning at the level he or she is capable of learning and may be experiencing negative social and emotional consequences.

Behaviors Related to Fatigue (Hincks-Dellcrest Centre, 2014) include:

- Often gives up easily as tasks become difficult
- Has poor frustration tolerance level
- Has difficulty concentrating on work and reduced productivity in many situations
- Makes careless mistakes
- Does not show creativity in solving problems
- Complains of feeling fatigued; falls asleep on the way home from school
- Does not seem to enjoy activities (especially social and/or in noisy conditions)

A recent study with adults with hearing loss found that sustained speech processing demands, such as decoding speech in noise, can lead to subjective reports of fatigue, particularly when listening without hearing aids (Hornsby, 2013). The question of fatigue in children with hearing loss was also investigated (Hicks & Tharpe, 2002; Hornsby, Werfel, Camarata, & Bess, 2014). Researchers (Hicks & Tharpe, 2002) confirmed that children with hearing loss exert more effort on listening tasks than their typically hearing peers. This was found to *not* be related to difference in language ability nor was the level of effort expended greater as the hearing loss level increased. Any degree of hearing loss, with or without amplification, resulted in greater effort. Students with hearing loss did not rate their level of effort higher than their typically hearing peers, suggesting that subjectively asking students about effort may not accurately identify the actual level expended as many of these students have never experienced a true easy listening situation in a school setting. A second study examined the question of fatigue in children with hearing loss as compared to age-matched typically hearing peers completing a standardized measure. Results indicated that even children with normal hearing subjectively report fatigue, but the group with hearing loss reported greater fatigue on all three subscales (general fatigue, sleep/rest fatigue, and cognitive fatigue; Hornsby et al., 2014). Therefore, it is reasonable to conclude that children with hearing loss expend more effort when listening than do children with typical hearing regardless of the noise condition and, as a result, have a higher level of fatigue than their class peers. The fatigue experienced by children with hearing loss *is* substantial, even when compared to children with other chronic health conditions, such as cancer, diabetes, and rheumatoid arthritis (Hornsby et al., 2014).

Have you considered the impact that fatigue from ineffective communication is having on school performance? It is common for audiologists to test speech recognition in the presence of background noise in a test booth as a way to predict whether or not a child is in need of an FM system or other accommodations in the classroom (i.e., SPIN, HINT, Functional Listening Evaluation). The assumption is if a child maintains good speech-recognition performance under test conditions, then an FM system is not needed. This assumption is lacking in that it does not take into account the excessive expenditure of effort and the resulting fatigue that exists for a child with hearing loss who is using listening to learn in a typical classroom (Hicks & Tharpe, 2002). Clearly, research indicates that the issue of listening in a classroom with a hearing loss is more complicated than simple measures of speech-recognition ability.

In the world of business, the impact of an effort-reward imbalance on fatigue and performance has been studied extensively. It has also been applied to schoolchildren, resulting in questionnaires for those in grades 4–9 (Fukuda et al., 2010). The resulting Informal Assessment of Fatigue and Learning (2014) can help to quantify if there is a learning effort-reward imbalance and overall level of fatigue.

Pace of Learning

Hearing loss creates barriers to learning in the typical classroom environment and can impact social interactions. This *invisible* barrier typically causes cumulative learning gaps due to fragmented hearing and incidental learning/overhearing deficits. Historically (Spencer & Marschark, 2010), most children with hearing loss experienced significant language delays in early childhood that prevented them from being ready for school, thus resulting in most being educated in restrictive school programs. The advent of newborn hearing screening and early identification of hearing loss has resulted in the families of many children with hearing loss receiving intensive early intervention services. A review of the collected post-universal newborn hearing screening research (Spencer & Marschark, 2010) revealed important outcomes including (1) parents expect that early identification and intervention will be sufficient to make their child like a hearing child, (2) children who are identified early and receive appropriate early intervention have been found to demonstrate language development in the “low average” level compared to hearing children, and (3) many if not most children with hearing loss who use listening and speaking for learning fail to keep pace with hearing peers (even those with cochlear implants). Although we live in a time when the potential of children with hearing loss is more likely to be reached than ever before, the reality is that the gains of early childhood are often eroded by the challenges of learning in a non-supportive auditory environment.

As a follow up to studies of language development of early identified children with hearing loss who received early intervention services, the continued trajectory of language learning once children entered school was examined (Yoshinaga-Itano, 2010). Language was comprehensively evaluated every 6 months between 4 through 7 years of age for 135 cognitively normal children with hearing loss of all degrees from English-speaking families. There were 49 cochlear implant users and 38 hearing aid users (mild-profound loss). Almost half of the children had delayed language at school entry and continued to have language delays at Age 7 (early intervention did not eliminate delays). Only 15% of children who had language delays closed their gap in language learning by Age 7. None of the children who had profound hearing loss and language delays at Age 4 closed their gap in language learning. Thirty-five percent had typical language at Age 4 and continued to do so at Age 7. Finally, of the children who entered school with "normal" language development, 10% had noticeable language gaps by the time they were in second grade. It is reasonable to expect that the percent of "gap openers" only increases as the curriculum and new vocabulary is introduced at a faster pace. The data from this study corroborates the finding from the comprehensive literature review (Spencer & Marschark, 2010) that many children with hearing loss who use listening and speaking for learning fail to keep pace with hearing peers.

Has the learning trajectory been reviewed over time? Asking the classroom teacher, "How does this student perform in you classroom?" is not an assessment of effective access to communication. If, upon school entry, a child had a standard score of 88 for language (low average) it was likely due to their decreased exposure to incidental language, or reduced overhearing, in early childhood. Without services to strengthen language and supports to ensure effective access to communication it would not be surprising for the child to achieve a lower standard score when reassessed. In the consideration of access and effective communication, one measure of the impact can be to review normative and curriculum-based assessment results over time to determine if performance is eroding.

The concern for school-age children is that the effects of fragmented hearing on effort, listening comprehension, and fatigue are not recognized by educators who erroneously assume that a good start to typical language learning inoculates a child from the learning challenges caused by being educated in a typical classroom environment. The Title II policy clarification now provides the impetus to ensure that students with hearing loss are receiving the auxiliary aids and services needed for them to receive effective communication access at school.

Auxiliary Aids and Services to Improve Effectiveness of School Communication

The Frequently Asked Question (2) of the Title II policy clarification states that auxiliary aids and services include a wide range of services, devices, technologies, and methods of providing effective communication, as well as the acquisition or modification of equipment or devices. In general, auxiliary aids and services make aurally or visually delivered information available to students with hearing, vision, or speech disabilities so that they can receive information from, and convey information to, others as effectively as students without disabilities.

The Title II clarification specifically addresses the requirement that interpreters must be qualified. This means that the interpreter must be able to interpret both receptively (having the skill needed to understand what the person with a disability is saying) and expressively (having the skill needed to convey information to the person with a disability). This communication must be conveyed effectively, accurately, and impartially, using any appropriate specialized vocabulary. The policy clarification further specifies that a teacher or other staff member who signs "pretty well" is not a qualified interpreter. Being able to sign "pretty well" does not mean that a person can process spoken communication into proper signs; nor does it mean that he or she has the proper skills to observe the person signing and change the signed or finger-spelled communication into spoken words.

Per the policy clarification, each student's access needs must be determined individually, considering the communication used by the student, the nature, length, and complexity of the communication involved, and the context in which the communication is taking place. This of course requires school staff who are knowledgeable in assessing communication effectiveness and issues.

Further, the clarification requires that the public school consider the number of people involved in the communication, the expected or actual length of time of the interaction(s), and the content and context of the communication. For example, will the communication with a deaf student be fairly simple so that handwritten or typed notes would suffice; or is the information being exchanged important, somewhat complex, technical, extensive, or emotionally charged, in which case, a qualified interpreter may be necessary. The Title II regulations' requirements apply to all of a student's school-related communications, not just those with teachers or school personnel. Therefore, given the ongoing exchanges students experience with teachers, students, coaches, and school officials, any student who requires a sign language interpreter in order to receive effective communication in an academic class would likely need interpreter services throughout the day and may also need them to participate in school-sponsored extracurricular activities. For a deaf or hard of hearing student, a sign language interpreter or CART may be appropriate where student comments and discussions are part of the class experience for all students. These purpose of these services would be to enable the student to understand comments and discussions from classmates that all students are exposed to, in addition to what is being said by the teacher, and to enable the student to express himself or herself in a manner that permits the teacher and classmates to fully understand and respond to the student (FAQ 4).

Tools for to Support Effective Communication Assessment and Collaboration include

- The Cascading Impact of Hearing Loss on Access to School Communication (Anderson, 2014c). To assist the hearing professional in discussing the access needs of children with hearing loss with the ADA Coordinator and school team.
- Accessibility Considerations Worksheet for Students with Hearing Loss (Anderson, 2014a). To aid in the process of data collection and discussion of student accessibility needs. Ideally, this worksheet would be used by school teams as a basis for discussing a student's level of access to effective communication, specifying the aspects to be considered as required by the Title II ADA policy clarification.
- Accessibility for Students with Hearing Loss–Auxiliary Aids and Services to Consider (Anderson, 2014b). Once a student has been identified as having communication access needs, this check sheet can be used as the basis to discuss appropriate auxiliary aids and services.

Summary

It is important for the educational audiologist, teacher of the deaf/hard of hearing, or speech-language pathologist to be knowledgeable in how to demonstrate the impact of hearing loss on access to classroom communication so that the question "Does this student have effective access to communication in school?" can be answered in an evidence-based manner. Information in this article has been provided to assist the educator with specialization in deaf/hard of hearing to provide answers to the following questions:

- Is the acoustic environment appropriate?
- Has the use of hearing technology maximized perception of speech sounds?
- What is the size of the student's "listening gap" under varying conditions, including lecture and class discussion?
- How much is the student utilizing speechreading? How effectively?
- Does the student have the memory capacity to cope with increased effort?

- What is the impact of fatigue from ineffective access to communication having on school performance?
- What is the student's learning trajectory over time?

Tools have been made available to assist the educational audiologist, speech-language pathologist, and/or teacher of the deaf/hard of hearing in discussing accessibility with the school team, collaborating on assessment, and determining necessary auxiliary aids and service needs to ensure that students with hearing loss is able to communicate as effectively at school as class peers.

References

Anderson, K. L. (2014a). Accessibility considerations worksheet for students with hearing loss. Retrieved from http://successforkidswithhearingloss.com/504-plans-ada

Anderson, K. L. (2014b). Accessibility for students with hearing loss–Auxiliary aids and services to consider. Retrieved from http://successforkidswithhearingloss.com/504-plans-ada

Anderson, K. L. (2014c). Cascading impact of hearing loss on access to school communication. Retrieved from http://successforkidswithhearingloss.com/504-plans-ada

American National Standards Institute. (2010). Acoustical performance criteria, design requirements, and guidelines for schools, Part 1: Permanent schools (S12.60–2010). New York, NY: Author.

Architectural and Transportation Barriers Compliance Board. (1999). Response to petition for rulemaking for classroom acoustics. *Federal Register, 63,* 29679–29684.

Beaman, C. P., & Roer, J. P. (2009). Learning and failing to learn in immediate memory. *31st Annual Meeting of the Cognitive Science Society, Austin, Texas, USA*. Retrieved from http://www.academia.edu/2407326/Learning_and_failing_to_learn_in_immediate_memory

Bodkin, K., Madell, J., & Rosenfeld, R. (1999). Word recognition in quiet and noise for normally developing children. American Academy of Audiology Convention, Miami, FL, Poster session. Retrieved from http://successforkidswithhearingloss.com/speech-perception

Boudreau, D., & Costanza-Smith, A. (2011, April). Assessment and treatment of working memory deficits in school-age children: The role of the speech-language pathologist. *Language, Speech, and Hearing Services in Schools, 42,* 152–166.

Bowers, L., Huisingh, R.., & LoGiudice, C., (2006). *The Listening Comprehension Test 2*. East Moline, IL: LinguiSystems. Retrieved from http://successforkidswithhearingloss.com/listening-comprehension-test-2

Bradley, J. (2005). Does the classroom assist or impede the learning process? Canadian Teacher Magazine. Retrieved from http://www.canadianteachermagazine.com/archives/ctm_current_research/winter05_classroom_acoustics.shtml

Crandell, C. C., & Smaldino, J. J. (2000). Classroom acoustics for children with normal hearing and with hearing impairment. *Language, Speech, and Hearing Services in Schools, 31,* 362–370.

Finitzo-Hieber, T., & Tillman, T. (1978). Room acoustics effects on monosyllabic word discrimination ability for normal and hearing-impaired children. *Journal of Speech and Hearing Research, 21,* 440–458.

Fraser, S., Gagné, J. P., Alepins, M., & Dubois, P. (2010). Evaluating the effort expended to understand speech in noise using a dual-task paradigm: The effects of providing visual speech cues. *Journal of Speech, Language, and Hearing Research, 53,* 18–33.

Fukuda, S., Yamano, E., Joudoi, T., Mizuno, K., Tanaka, M., Kawatani, J., . . . Watanbe, Y. (2010). Effort-reward imbalance for learning is associated with fatigue in school children. *Behavioral Medicine, 36*(2), 53–62.

Informal Assessment of Fatigue and Learning. (2014). Retrieved from http://successforkidswithhearingloss.com/wp-content/uploads/2011/08/Fatigue-and-Learning-Scale.pdf

Hartman, G. (1946). The effects of noise on children. *Journal of Educational Psychology, 37,* 149–161.

Hicks, C. B., & Tharpe, A. M. (2002). Listening effort and fatigue in school-age children with and without hearing loss. *Journal of Speech, Language, and Hearing Research, 45,* 573–584.

Hincks-Dellcrest Centre (2014). The sad child—low energy or fatigue. *The ABCs of mental health.* Retrieved from http://www.hincksdellcrest.org/ABC/Teacher-Resource/The-Sad-Child/Low-Energy-or-Fatigue.aspx

Hornsby, B. W. Y. (2013). The effects of hearing aid use on listening effort and mental fatigue associated with sustained speech processing demands. *Ear and Hearing, 34*(5), 523–534.

Hornsby, B. W. Y., Werfel, K., Camarata, S., & Bess, F. (2014), Subjective fatigue in children with hearing loss: Some preliminary findings. *American Journal of Audiology, 23,* 129–134. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4096811/

Howard, C. S., Munro, K. J., & Plack, C. J. (2010). Listening effort at signal-to-noise ratios that are typical of the school classroom. *International Journal of Audiology, 49,* 928–932.

Irwin, R. J., & McAuley, S. F. (1987). Relations among temporal acuity, hearing loss, and the perception of speech distorted by noise and reverberation. *Journal of the Acoustical Society of America, 81,* 1557–1565.

Johnson, C. D., & Von Almen, P. (1997). The functional listening evaluation. In C. D. Johnson, P. V. Benson, & J. B. Seaton (Eds.), *Educational Audiology Handbook* (336–339). San Diego, CA: Singular Publishing Group. Retrieved from http://successforkidswithhearingloss.com/tests

Knecht, H. A., Nelson, P. B., Whitelaw, G. M., & Feth, L. L. (2002). Background noise levels and reverberation times in unoccupied classrooms: Predictions and measurements. *American Journal of Audiology, 11*(2), 65–71.

Lewis, D., Manninen, C. M., Valente, D. L., & Smith, N. A. (2014). Children's understanding of instructions presented in noise and reverberation. *American Journal of Audiology, 23,* 326–336.

Martin, N. A., & Brownell, R. (2005) *Test of Auditory Processing Skills, Third Edition* (TAPS-3). Novato, CA: Academic Therapy Publications. Retrieved from http://successforkidswithhearingloss.com/taps-3

Nabelek, A. K., & Pickett, J. M. (1974a). Monaural and binaural speech perception through hearing aids under noise and reverberation with normal and hearing-impaired listeners. *Journal of Speech and Hearing Research, 17,* 724–739.

Nabelek, A. K., & Pickett, J. M. (1974b). Reception of consonants in a classroom as affected by monaural and binaural listening, noise, reverberation and hearing aids. *Journal of the Acoustic Society of America, 56,* 628–639.

Nagane, M. (2004). Relationship of subjective chronic fatigue to academic performance. *Psychological Reports, 95*(1), 48–52.

Ostergren, D., & Smaldino, J. (2012). Technology in educational settings. It may already be in your pocket! *Journal of Educational Audiology 18,* 10–13. Retrieved from http://c.ymcdn.com/sites/www.edaud.org/resource/resmgr/Journal_-_2012_Issue/JEA-2012_8_formatted.pdf November 24, 2014.

Picou, E. M., Ricketts, T. A., & Hornsby, B. W. Y. (2011). Visual cues and listening effort: Individual variability. *Journal of Speech. Language, and Hearing Research, 54,* 1416–1430.

Pittman, A. (2011). Children's performance in complex listening conditions: Effects of hearing loss and digital noise reduction. *Journal of Speech, Language, and Hearing Research, 54,* 1224–1239.

Sarampalis, A., Kalluri, S., Edwards, B., & Hafter, E. (2009). Objective measures of listening effort: Effects of background noise and noise reduction. *Journal of Speech, Language, and Hearing Research, 52,* 1230–1240.

Schafer, E., Bryant, D., Sanders, K., Baldus, N., Lewis, A., Traber, J., Layden, P., Amin, A., & Algier, K., (2013). Listening comprehension in background noise in children with normal hearing. *Journal of Educational Audiology, 19,* 58–64. Retrieved from http://c.ymcdn.com/sites/www.edaud.org/resource/resmgr/Journal_-_2013_Issue/JEA_2013_FINAL_2.pdf

Smaldino, J., & Ostergren, D. (2012). Classroom acoustic measurements. In J. Smaldino & C. Flexer (Eds.), *Handbook of Acoustic Accessibility* (pp. 34–54). New York, NY: Thieme. Retrieved from http://www.nhdeafhhed.org/images/guidelines/Resources/Audiology/ansi.pdf on November 24, 2014.

Spencer, P. E., & Marschark, M. (2010). Evidence-based practice in educating deaf and hard-of-hearing students. New York, NY: Oxford University Press.

Tyler, R. S., Preece, J., & Lowder, M., (1983). *The Iowa cochlear implant tests.* Iowa City, IA: University of Iowa, Department of Otolaryngology, Head and Neck Surgery. Retrieved from http://successforkidswithhearingloss.com/speech-perception

United States Departments of Education and Justice. (2014a). *Frequently asked questions on effective communication for students with hearing, vision, or speech disabilities in public elementary and secondary schools.* Retrieved from http://www2.ed.gov/about/offices/list/ocr/docs/dcl-faqs-effective-communication-201411.pdf

United States Departments of Education and Justice. (2014b). *Policy clarification letter, dated November 12, 2014*. Retrieved from http://www2.ed.gov/about/offices/list/ocr/letters/colleague-effective-communication-201411.pdf

Valente, D. L., Plevinsky, H. M., Franco, J. M., Heinrichs-Graham, E. C., & Lewis, D. (2012). Experimental investigation of the effects of the acoustical conditions in a simulated classroom on speech recognition and learning in children. *Journal of the Acoustical Society of America, 131*(1), 232–246.

Wepman, J. M., & Reynolds, W. M. (1987). Wepman's Auditory Discrimination Test, Second Edition. Western Psychological Services, CA. Available from http://successforkidswithhearingloss.com/adt

Winch, W. H., (1912). Mental fatigue in day school children as measured by immediate memory: Part I. *Journal of Educational Psychology, 3,* 18–28.

Yoshinaga-Itano, C. (2010, October). *The longitudinal language learning of infants and children with hearing loss*. Presented at the ASHA Virtual EHDI Conference.

History:
Received December 8, 2014
Revised January 21, 2015
Accepted Feruary 3, 2015
doi:10.1044/hhdc25.1.24