Aided Speech Perception Testing Practices for Three-to-Six-Year Old Children With Permanent Hearing Loss

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Routine early identification and management of hearing loss in infants is relatively recent because newborn hearing screening has become a standard of care in the United States. More children are identified with hearing loss earlier and achieve age-appropriate speech and language skills. This means that younger children have the skills needed to participate in more challenging, open-set speech perception testing procedures. This study examined current practice patterns of pediatric audiologists to provide insight into how speech perception testing is being utilized to validate aided benefit for this population.

The present study used a cross-sectional survey design. The survey consisted of 23 questions that addressed four aspects of audiology practice: (1) practice demographics, (2) speech perception tests used based on age (i.e., 3-year-olds, 4-year-olds, 5-year-olds, 6-year-olds), (3) test variables and conditions, and (4) communication and collaboration with speech-language pathologists and educators. The survey was completed anonymously online. One hundred and forty-five audiologists from 37 states completed the survey (14% return rate). One-quarter of the pediatric audiologists who responded who work with preschool-aged children with hearing loss do not include aided speech perception testing. Audiologists reported selecting three tests most frequently and using monitored live voice more often (82%) than recorded speech. In addition, the presentation level selected varied among providers. Further research is needed to better provide guidance for testing decisions and understand how test parameters contribute to speech perception performance for preschool-aged children with hearing loss.

Introduction

Hearing loss is now routinely identified at two to three months of age in the United States as a result of universal newborn hearing screening (White, Forsman, Eichwald, & Muñoz, 2010). This has an impact on all aspects of service delivery for young children with hearing loss, and given appropriate access to audiological and early intervention services, many children have the potential to follow a typical developmental trajectory (e.g., Robbins, Koch, Osberger, Zimmerman-Phillips, & Kishon-Rabin, 2004). Pediatric audiologists have a central role throughout the process, from identification to intervention. Speech perception testing can provide audiologists with valuable information about how a child is using hearing to discriminate and comprehend speech and language. However, assessment of benefit from hearing technology using aided speech perception measures for preschool-aged children and related interdisciplinary collaboration are often underutilized. As more children are identified with hearing loss earlier and achieve age-appropriate speech and language skills, preschool children (i.e., children ages 3- to 5-years-old) have the ability to participate in more challenging speech perception testing procedures. This study examined current practice patterns of pediatric audiologists to provide insight into how speech perception testing is being utilized to validate benefit for this population.

For children who are learning spoken language and use hearing technology, audiology services are fundamental to successful intervention. In fact, decisions made regarding hearing technology can positively or negatively impact child outcomes. Pediatric audiologists have a responsibility to provide comprehensive evidence-based services, and practice guidelines are available (American Speech Language and Hearing Association [ASHA], 2004; American Academy of Audiology [AAA], 2003, 2008; Joint Committee of Infant Hearing [JCIH], 2007). Even though guidelines are available, there are factors that influence the field (e.g., age of identification, changes in hearing technology) faster than guidelines can be updated. For this reason, clinical judgment and professional accountability for remaining current in pediatric hearing issues are also critical components when making decisions for each individual child.

Many audiologists who work with children with hearing loss do not provide aural habilitation services; however, they are responsible for measuring outcomes and validating benefit over time through ongoing audiological monitoring services. One way to measure benefit is through speech perception testing. These measures offer audiologists an opportunity to measure functionality of a child's communicative abilities (Blamey, 2001). Speech perception has been positively correlated to speech and language performance in school-age children (Blamey, et al., 2001; Eisenberg, Martinez, Holowecky & Pogorelsky, 2002; Spencer, Tye-Murray, & Tomblin, 1998; Stelmachowicz, Pittman, Hoover & Lewis, 2002; DesJardins, Ambrose, Martinez, & Eisenberg, 2009) and, more recently, preschool-age children. For example, in a

recent study by Ambrose, Fey, and Eisenberg (2012), preschoolers' speech perception scores as measured by the Play Assessment of Speech Pattern Contrasts (PLAYSPAC; Boothroyd, Eisenberg, & Martinez, 2006; Eisenberg, Martinez, & Boothroyd, 2007) were significantly positively related to speech production, language comprehension and expression, and early literacy measures (i.e., phonological awareness and print knowledge). This relationship provides audiologists with a rationale to include speech perception measures as part of their validation practices for young children.

Regrettably, direction provided by practice guidelines related to validation is minimal. For example, the AAA (2003) pediatric amplification guideline offers recommendations of certain speech perception tests that can be considered; however, there are no recommendations related to test conditions and variables (e.g., presentation level, mode of presentation). The guideline also indicates that monitoring appointments are recommended every three months for the first two years following the fitting, then every four to six months, and periodic validation should be provided. Similarly, the ASHA (2004) guideline recommends speech perception as part of the assessment protocol for children who are developmentally 25 to 60 months of age. The recommendations include tests to consider but no recommendations related to test conditions. Because of a lack of systematic recommendations related to outcome evaluations, the Pediatric Audiological Monitoring Protocol (PedAMP) was developed (University of Western Ontario, 2012), and while this resource offers valuable direction, its scope does not include aided speech perception testing.

Prior to advances in newborn hearing screening, the average age of identification of hearing loss was between 2 ½ and 3 years of age (ASHA, 2012), and audiologists relied on closed-set speech perception tasks (e.g., picture identification from a limited set of items) due to limitations of a child's intelligibility or vocabulary skills. Today, because children are identified with hearing loss at younger ages and are enrolled in early intervention services, they often have the potential to develop speech and language skills commensurate with their age-matched hearing peers. With that in mind, it is important for audiologists consider use of open-set speech perception tests that are sensitive enough to measure the most advanced level of the child's speech perception development, and, more importantly, functional communicative performance. As audiologists work with increasing numbers of children from cultural and linguistically diverse backgrounds, it is important that they have access to speech perception tests that assess a child's development in their native language to maximize the sensitivity obtained from these measures.

Optimizing outcomes for children with hearing loss involves multidisciplinary collaboration and effective teaming among the parents and professionals involved for each child. Speech perception testing offers an integrated look at the relationship between speech perception and speech production and can also be an indicator of later language development (Blamey, et al., 2001). When audiologists and speech-language pathologists collaborate regarding results from these measures, they are better able to analyze the nature of the errors and to determine the intervention path that best addresses the child's needs. This path may include increased or different strategies in intervention, modifications to a child's hearing technology, and/or consideration of an alternate hearing device.

The purpose of this study was to better understand test protocols and procedures that are currently being used by pediatric audiologists who work with 3- to 6-year-old children who have permanent hearing loss.

Methods

The study used a cross-sectional survey design. A pediatric audiologist and a speech-language pathologist developed the survey and piloted the survey with nine audiologists in Utah to determine question clarity. The Utah State University Institutional Review Board approved the study methods. The survey consisted of 23 questions that addressed four aspects of audiology practice: (1) practice demographics, (2) speech perception tests used based on age (i.e., 3-year-olds, 4-year-olds, 5-year-olds, 6-year-olds), (3) test variables and conditions, and (4) communication and collaboration with speech-language pathologists and educators. The survey was completed anonymously online.

Data Collection

Pediatric audiologists were recruited to participate through children's hospitals, university programs, and the Educational Audiology Association membership. In January 2012, 1,072 audiologists were sent an invitation to complete the survey; a postcard that included the website address to complete the survey was mailed through the U.S. postal service for those who did not have an accessible email address (94 audiologists). A reminder was sent two weeks after the initial mailing.

Data Analysis

Results from the surveys were coded in an Excel file and checked for accuracy and completeness. Data were analyzed using SPSS to calculate descriptive statistics, including frequencies and percentages.

Results

One hundred and forty-five audiologists from 37 states completed the survey (14% return rate). Twelve of the respondents were not included in the analysis because they reported that they did not work with 3- to 6-year-old children with permanent hearing loss. Of the remaining 133 respondents, 32 (24%) reported that they did not perform aided speech perception testing. The reasons the audiologists reported that speech perception testing was not provided included that the children were followed by their private audiologist, there was not enough time to complete testing, they used real ear measures, and they did not have sound field testing capabilities. Therefore, analyses were conducted with the 101 respondents who provided aided speech perception testing.

Practice Demographics

Audiologists were asked about their primary work setting, how long they had been practicing audiology, and to report on various aspects of testing 3- to 6-year-olds with permanent hearing loss (see Table 1). The majority of respondents worked in public schools and hospitals. The remainder of the respondents were grouped into a category referenced as "other" in Table 1 and reported working in the following settings: private practice (n = 4), State School for the Deaf (n =5), University clinic (n = 9), non-profit center (n =1), state-affiliated clinic (n =1), private school (n =1), and more than one setting was reported (n = 10). Eighty-three percent of the respondents had been working eight or more years.

Audiologists reported that the children they follow used the following types of hearing technology: hearing aids only (31%), cochlear implants only (3%), and both hearing aids and cochlear implants (66%). Almost half (49%) of the respondents reported following over 15 children on a regular basis and reported that this population made up less than a quarter of their overall schedule during the previous month. Audiologists were also asked how often they typically monitor hearing for these children and how often they include aided speech perception testing. The majority (66% and 69%, respectively) reported every six months or annually for both questions. One-quarter (25%) of the respondents reported other monitoring schedules, such as they make decisions specific to each child's needs, that an audiologist at another facility does the testing, or that they complete testing when they receive a referral. Other answers for testing aided speech perception included at every visit, whenever hearing technology is checked, and variable schedules.

Table 1. Practice Demographics of Audiologists Who Perform Aided Speech Perception Testing for Children 3- to 6-years-old With Permanent Hearing loss

	Public School 40% (n = 40)	Hospital 30% (n = 30)	Other 31% (n = 31)
Years in practice			
<3 years	2 (05)	4 (13)	4 (13)
3 to 7 years	2 (05)	4 (13)	2 (06)
8 to 15 years	5 (13)	10 (34)	4 (13)
>15 years	30 (77)	12 (40)	21 (68)
Children followed on a regular basis			
1 to 5	12 (30)	2 (07)	15 (48)
6 to 10	6 (15)	7 (23)	2 (06)
11 to 15	3 (07)	2 (07)	3 (10)
> 15	19 (48)	19 (63)	11 (35)
Percent of practice during previous month			
1 to 25%	31 (78)	15 (50)	23 (74)
26 to 50%	6 (15)	6 (20)	3 (10)
51 to 75%	7 (08)	6 (20)	2 (06)
76 to 100%	0	3 (10)	3 (10)
Routine audiological monitoring			
Annually	8 (20)	2 (07)	5 (16)
Every 6 months	20 (50)	22 (73)	9 (29)
Every 3 months	1 (02)	2 (07)	3 (10)
As needed	3 (08)	0	1 (03)
Other	8 (20)	4 (13)	13 (42)
Aided speech perception testing			
Annually	12 (30)	7 (23)	7 (23)
Every 6 months	20 (50)	15 (50)	9 (29)
Every 3 months	1 (2.5)	2 (07)	4 (13)
As needed	1 (2.5)	0	1 (03)
Other	6 (15)	6 (20)	10 (32)

Speech Perception Testing

A variety of speech perception tests were used for each age (i.e., 3-, 4-, 5-, and 6-year-olds), and the preferences shifted based on age (see Table 2). The most frequently used tests for the 3-, 4-, and 5-year-olds were the Phonetically Balanced Kindergarten Lists (PBK; Haskins, 1949), the Word Intelligibility by Picture Identification Test (WIPI; Ross & Lerman, 1971), and the Northwestern University Children's Perception of Speech (NU-CHIPS; Elliott & Katz, 1980). For the 6-year-olds, the most frequently used tests were the PBK, WIPI, and Bamford-Kowal-Bench Speech-in-Noise sentences (BKB-SIN; Etymōtic Research, 2005). Other tests and/or tasks reported included asking children to point to body parts, Mr. Potato Head task (Robbins, 1994), speech recognition threshold, Common Phrases (Robbins, Renshaw, & Osberger, 1995), Pediatric Speech Intelligibility test (PSI; Jerger & Jerger, 1984), Test of Auditory Comprehension (TAC; Trammell,

1976), Plurals test (Glista & Scollie, 2012), Ling Six Sound Test (Ling, 2002), the Speech Perception Instructional Curriculum and Evaluation (SPICE; Moog, Biedenstein, & Davidson, 1995) curriculum, and the Glendonald Auditory Screening Procedure (GASP; Erber, 1982). When test choice was compared by age for the two most common work environments (i.e., hospitals and public schools) responses were similar. For example, for the PBK, 27% of audiologists in hospitals and 39% in public schools used this test for 3-year-olds, and 70% of audiologists in hospitals and 65% in public schools used this test for 5-year-olds.

For each test, audiologists were asked how many words/sentences they typically present (i.e., full list, half list, other) and if the stimuli are presented using monitored live voice (MLV) or with a recording (see Table 2). For the tests most frequently used, audiologists reported using a full list for the WIPI and BKB-SIN (one list pair) and a half list for the PBK and NU-CHIPS. For all tests except the BKB-SIN, the majority of the audiologists reported presenting the words using MLV.

level (n = 94, 93%). The second most common condition was testing in noise at an average conversational speech level (n = 72, 71%), but only about one-third test at a soft speech level (n = 36, 35%). Other conditions reported (n = 11, 10%) were both quiet and noise, auditory versus auditory visual, with/without frequency-modulated (FM) system, and soft speech with equivalent noise. For each of the three conditions (i.e., average conversational speech level in quiet and in noise, and soft speech level), most respondents performed the assessment binaurally only. For an average conversational speech level in quiet, approximately one-third performed the assessment binaurally and for each ear separately (see Table 3 on page 10).

The levels audiologists reported performing testing for average conversational speech in quiet ranged from 30 to 65 dB HL (n = 91); the most frequently reported level was 50 dB HL (42%). When testing in noise at an average conversational speech level, audiologists reported presenting speech at levels ranging from 40 to 70 dB HL (n = 61); the most frequently reported level

Test Variables and Conditions

Several factors are considered when deciding which speech perception test to use. Audiologists reported considering the following: language level (n = 85, 84%), developmental level (n = 85, 84%), speech intelligibility (n = 78, 77%), primary language (n = 60, 59%), chronological age (n = 54, 53 %), and other factors (n = 12, 11%). Other factors audiologists considered were attention skills, child's cooperativeness, whether the child has behavior issues, activity level/state, previous tests used and outcomes, child's temperament on a particular day, auditory language age, listening age, maturity, audiologist's personal judgment and impression of the child.

Audiologists were asked what test conditions they typically use when assessing speech perception. The most common condition was in quiet at an average conversational speech

Table 2. Frequency of Use of Speech Perception Tests, Number of Words Presented, and Mode of Presentation for Children by Age

Test	3 Years	4 Years	5 Years	6 Years
ESP	31	17	8	7
Whole List (Half List)	21 (2)	12 (1)	7 (0)	6 (0)
MLV (Recorded)	27 (3)	14 (2)	8 (0)	7 (0)
PBK	43	57	73	64
Whole List (Half List)	2 (36)	5 (49)	8 (62)	12 (50)
MLV (Recorded)	36 (6)	47 (10)	57 (13)	49 (13)
MLNT	8	10	12	10
Whole List (Half List)	8 (0)	10 (0)	12 (0)	10 (0)
MLV (Recorded)	5 (3)	6 (4)	8 (4)	8 (2)
LNT	11	13	14	16
Whole List (Half List)	11 (0)	12 (0)	14 (0)	15 (0)
MLV (Recorded)	6 (3)	9 (2)	10 (3)	12 (3)
WIPI	67	62	45	23
Whole List (Half List)	51 (13)	49 (10)	37 (6)	20 (2)
MLV (Recorded)	61 (6)	52 (5)	40 (3)	21 (1)
NU-CHIPS	54	43	30	20
Whole List (Half List)	5 (44)	5 (36)	10 (19)	9 (9)
MLV (Recorded)	43 (10)	34 (8)	24 (5)	15 (5)
HINT-C	7	8	12	17
Whole List (Half List)	6 (0)	7 (1)	10 (1)	12 (3)
MLV (Recorded)	5 (2)	5 (3)	5 (7)	5 (12)
BKB-SIN	8	11	17	25
Whole List (Half List)	5 (1)	10 (1)	15 (1)	21 (1)
MLV (Recorded)	2 (6)	2 (9)	3 (14)	7 (18)
CNC	4	4	5	13
Whole List (Half List)	1 (3)	0 (3)	0 (5)	2 (10)
MLV (Recorded)	3 (1)	1 (2)	1 (4)	7 (6)
Other	21	14	19	25

ESP = Early Speech Perception; PBK = Phonetically Balanced Kindergarten List; MLNT = multi-Syllabi Lexical Neighborhood Test; LNT = Lexical Neighborhood Test; WIPI = Word Intelligibility by Picture Identification; NU-CHIPS = Northwestern University Children's Perception of Speech; HINT-C = Hearing in Noise Test for Children; BKB-SIN = Bamford-Kowal-Bench sentences; CNC = Consonant-Nucleus-Consonant Test; MLV = monitored live voice

for presentation of speech was 50 dB HL (48%). The signal-to-noise ratio (SNR) ranged from 0 to +20 dB; the most frequently reported SNR was +5 SNR (44%).

Approximately two-thirds of the audiologists reported marking the specific errors made during speech perception testing (n = 72, 71%). Open-ended responses were elicited to identify how audiologists use speech perception test results. Only one-quarter (24%) of the audiologists provided a response and reported a variety of ways in which speech perception test results were used: to validate the hearing aid fitting; to give feedback to speech-language pathologist, teacher, and parents; to help guide amplification adjustments; to monitor progress of vocabulary, performance and/or performance changes; as a basis for developing auditory goals; to compare to previous testing to see if improvement occurs or if a problem is evident; to advocate for the need for a FM system.

When the child's primary language was not English, speech perception testing was provided less frequently (n = 40, 39%). When testing was provided, it was most often done in English (n = 26, 65%), a few audiologists provided testing in the child's own language (n = 3, 7%), and some tested in both English and the child's primary language (n = 10, 25%). Audiologists reported that they used the following tests for children whose primary language was not English: Consonant-Nucleus-Consonant (CNC; Peterson & Lehiste, 1962), a picture identification task, WIPI, Early Speech Perception (ESP; Moog & Geers, 1990), Mr. Potato Head, Hearing in Noise Test - Children (HINT-C; Nilsson, Soli, & Gelnett, 1996), and NU-CHIPS. When another language was used during testing, audiologists reported that the language was Spanish or other languages as available through interpreters.

Communication and Collaboration

The extent of communication and collaboration with providers who work closely with the child (i.e., speech-language pathologist, deaf educator/teacher) varied from one audiologist to another (see Table 4). Approximately one-third of the audiologists (n=38, 38%) reported that they frequently or always obtain speech-language assessment scores from the speech-language pathologist, and approximately two-thirds of the audiologists share speech perception test results with the child's speech-language pathologist and teacher (n = 75, 74% and n = 69, 69%, respectively. Just under half (48%) of respondents reported that they collaborate with these professionals to interpret speech perception test results.

Table 3. Aided Speech Perception Test Conditions Used by Audiologists

Test Condition	N	Binaurally only	Each Ear Separately	Both Binaural and Separately
Average Conversation				
Quiet	94	42 (45%)	14 (15%)	37 (39%)
Noise	72	52 (72%)	3 (4%)	18 (25%)
Soft Speech	36	21 (58%)	6 (17%)	9 (25%)

Table 4. Percent of Time Information is Shared Between the Audiologist and the Speech-Language Pathologists (SLP) and Deaf Educator (DE)

	N	Never	Sometimes	Frequently	Always
How often does the SLP/DE communicate speech-language assessment scores to you?	99	17	44	28	10
How often do you share speech perception results with child's SLP?	101	3	23	36	39
How often do you share speech perception results with the child's teacher/educator?	100	7	24	33	36
How often do you collaborate with the SLP/DE to interpret speech perception results?	101	13	40	37	11

Discussion

Routine early identification and management of hearing loss in infants is relatively recent, as newborn hearing screening has become a standard of care in the United States. This survey of pediatric audiologists was conducted to understand practice patterns currently being utilized to validate performance of young children using hearing technology with speech perception measures. The survey results revealed a gap in practice related to assessment of aided speech perception for preschool-aged children. One-quarter of the pediatric audiologists who responded that work with preschool-aged children with hearing loss, do not include aided speech perception testing. When this testing is included, audiologists reported monitoring speech perception every six months to one year. The survey results revealed considerable variability among audiologists related to testing decisions (e.g., presentation level, test condition)

that could make comparison of test results between sessions and across clinics challenging.

A number of variables go into test selection, and the majority of audiologists reported considering multiple factors when choosing a test (e.g., developmental level, language level). Even with these considerations, there were three tests that audiologists reported selecting most frequently (i.e., PBK, WIPI, and NU-CHIPS) for preschool-aged children. Of these tests, the PBK was the most commonly given test, and the only, open-set speech perception measure administered to preschool children. Because children with hearing loss are identified and fit early, more children are able to successfully participate in open-set testing at earlier ages. While closed-set tasks can be easier to control and score particularly in younger populations, they offer limited ability to measure a child's functional use or performance in every day communicative situations (Blamey et al., 2001). There is a need for more research examining performance of preschool children on open-set speech perception measures, such as the PBK.

Because there is a positive relationship between speech perception and speech-language measures, collaboration between a speech-language pathologist and audiologist is particularly important to effectively interpret results from open set speech perception tasks as they pertain to functional communication outcomes of young children. While the majority of audiologists consider speech intelligibility and language level as an important part of test selection, only 38% of audiologists regularly obtained speech-language results from a speech-language pathologist. Both speech-language pathologists and audiologists can benefit from communication about results on these assessments and can collaborate about how these results can be interpreted in terms of modifications of hearing technology and/or intervention plans. Because audiologists see children less often than speech-language pathologists, this type of collaboration can be particularly helpful for preparing for appointments. Speech-language pathologists can offer insights into a child's progress, concerns, and consistency of use. When results are shared, it is easier for both professionals to use the data to monitor progress and to ensure that the child is receiving maximum benefit from technology as well as demonstrating progress in speech production.

Speech perception can be measured in various conditions to validate abilities using hearing technology, including in quiet and noise, at an average conversational speech level and at a soft speech level. Survey results revealed that audiologists use a variety of intensity levels for each of those conditions, resulting in significant variability among audiologists even for the same condition. For example, when audiologists reported testing speech perception in quiet at an average conversational speech level, they indicated using intensity levels ranging from 30 to 65 dB HL. Practice guidelines do not indicate standard presentation levels, and this may contribute to this variability. Madell and Flexer (2008) provided specific recommendations for children regarding presentation levels and test conditions. Recommendations include testing in quiet at normal conversation speech (50 dB HL) and at soft conversational speech (35 dB HL), and testing in competing noise (4 talker babble) at normal conversational speech (50 dB HL) with a +5 signal-to-noise ratio (SNR) and with a 0 SNR and at soft conversational speech (35 dB HL) with a 0 SNR. However, research studies that provide information about performance expectations for preschool-aged children with hearing loss are not available. It should be noted that the purpose of the test influences decisions and is dictated by the information the audiologist is seeking. The current study did not investigate which tests audiologists used for testing in quiet versus noise; although, there are test selection considerations that should be taken into account. For example, if a test were not designed for testing in noise it may not be an appropriate test to select.

Practice guidelines also do not provide direction related to the mode of presentation for speech perception testing. Stimuli used to measure speech perception can be presented either MLV or recorded speech. In this sample, audiologists used MLV more often (82%) than recorded for the three most frequently used tests. There have been numerous publications indicating recorded presentation is the preferred practice and essential for reliability (Roeser & Clark, 2008); however, this has been addressed primarily for the adult population. Measurement of speech perception abilities using recorded speech allows for standardization and for the results to reliably be compared among test sessions and between clinics. Audiologists have reported preferring MLV because it provides greater flexibility and is quicker to administer. According to a national practice survey, 82% of audiologists reported using MLV as the mode of stimulus presentation for adults (Martin, Champlin, & Chambers 1998).

There were several limitations to the current study and the small sample size limits the ability to infer broader practice patterns. The survey was completed electronically, and most respondents were notified via email to request their participation. Participants were notified twice, and further attempts to solicit participant response were not made, which may have influenced the low response rate of 14%. However, the response rate is similar to other surveys of healthcare providers. For example, a survey of speech-language pathologists had a response rate of 19.6% (Kalkhoff & Collins, 2012), and two surveys of physicians (Grava-Gubins & Scott, 2008) and residents (Westfal, Burrowes, Shorter, & Wright, 2011) had response rates of 29.9 and 8.7% respectively. The survey was anonymous, and clarification of responses could not be attempted, which limited ability to interpret results. For example, some

speech perception tests can be used as an open- or closed-set test (e.g., WIPI), and the option to indicate how the test was used was not provided in the survey. Similarly, audiologists were asked what criteria they used to select tests (e.g., developmental level, language level) but the survey did not explore how audiologists obtained this information.

Further research is needed to better understand how test parameters (e.g., presentation level, mode of presentation, use of open-set tasks) contribute to speech perception performance for preschool-aged children with hearing loss. Evidence-based protocols would enhance the audiologists' ability to use aided speech perception testing to estimate real-world listening skills and support the integration of evidence-based validation practices in routine care. Speech perception testing provides valuable information (Boothroyd, 2004, p. 292) "to distinguish capacity from performance, to guide decisions about the need for, and choice of, sensory assistance, to optimize adjustments of sensory devices, to assess the immediate outcome of sensory assistance, to guide decisions about habilitative interventions, to monitor and evaluate the success of that intervention, and in general, to promote evidence-based practice."

Conclusion

Audiologists are encountering a new population of young children with hearing loss, children who have had the benefits of early identification and intervention. Advantages to child development offered by this shift are significant and audiological practices to support and monitor children need to be sensitive, timely and appropriate. Further research on practices for this population is required to guide effective service provision for amplification validation using speech perception measures.

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