PRECISe Preschool Speech and Language
Publications

PRECISe: Practice-based Research
Collaborative in Speech-Language Pathology

2022

What do Speech-Language Pathologists want to know when assessing vocal development in children who are deaf/Hard-of-Hearing?

Olivia Daub
Western University, odaub@uwo.ca

Marlene P. Bagatto
Western University, bagatto@nca.uwo.ca

Janis Oram Cardy
Western University, janis.cardy@uwo.ca

What do SLPs want to know when assessing vocal development in CDHH?

Abstract

Purpose: Delays in vocal development are an early predictor of ongoing language difficulty for children who are deaf/hard-of-hearing (CDHH). Despite the importance of monitoring early vocal development in clinical practice, there are few suitable tools. This study aimed to identify the clinical decisions that speech-language pathologists (SLPs) most want to make when assessing vocal development and their current barriers to doing so.

Method: 58 SLPs who provide services to CDHH younger than 22 months completed a survey. The first section measured potential barriers to vocal development assessment. The second section asked SLPs to rate the importance of 15 clinical decisions they could make about vocal development.

Results: SLPs believed assessing vocal development was important for other stakeholders, and reported they had the necessary skills and knowledge to assess vocal development. Barriers primarily related to a lack of commercially available tests. SLPs rated all 15 clinical decisions as somewhat or very important. Their top 5 decisions included a variety of assessment purposes that tests are not typically designed to support, including measuring change, differential diagnosis, and goal setting.

Conclusions: SLPs wish to make a number of clinical decisions when assessing vocal development in CDHH but lack access to appropriate tools to do so. Future work is needed to develop tools that are statistically equipped to fulfill these purposes. Understanding SLPs' assessment purposes will allow future tests to better map onto the clinical decisions that SLPs need to make to support CDHH and their families and facilitate implementation into clinical practice.

What do Speech-Language Pathologists want to know when assessing early vocal development in children who are (D)eaf/hard-of-hearing?

Early linguistic experiences influence infants' processing of future linguistic experiences and lay the foundation for later language outcomes (e.g., Jansson-Verkasalo et al., 2010; Johnson & Jusczyk, 2001; Kuhl et al., 2008; Moon, Lagercrantz & Kuhl, 2012; Nazzi & Ramus, 2003; Tsao et al., 2004; Thiessen & Saffran, 2007; Werker & Tees, 1984). Permanent childhood hearing loss reduces infants' and children's experience with spoken language (Moeller & Tomblin 2015) and children who are deaf/hard-of-hearing (CDHH) are at increased risk for poorer overall spoken language outcomes than their typically-hearing peers (Joint Committee of Infant Hearing, 2013; Moeller, 2000; Nelson et al., 2008; Patel & Feldman, 2011). Hearing loss itself is not a language learning disorder, but a sensory disorder that impoverishes the child's linguistic environment with cascading effects on language learning and development. When the impact of hearing loss on CDHH's language environment is adequately mitigated, it is expected that CDHH can acquire language, either signed or spoken, within the expectations established for their same-aged peers (Joint Committee of Infant Hearing, 2013).

Early Hearing Detection and Intervention (EHDI) programs are committed to mitigating the impact of hearing loss on early linguistic experiences through the early identification of hearing loss and timely, comprehensive supports to families and children in order to create rich (signed or spoken) language learning environments. Within EHDI programs, the choice to pursue signed or spoken language is the family's (Moeller et al., 2013), with support from EHDI service providers (e.g., sign-language consultants, audiologists, speech-language pathologists).

Monitoring language development has been argued to be crucial for identifying CDHH who are showing signs of difficulty in language learning so that intervention efforts, either

technological or behavioural, can be tailored (Joint Committee of Infant Hearing, 2013; Moeller et al., 2013). Beyond intervention planning and family counselling, language outcome monitoring is also recommended to inform broader curricular and resource decisions at the level of the overall EHDI program. Of interest in the present paper is the measurement of early vocal development for families who choose to teach their child a spoken language. For the purposes of the present paper, vocal development is defined as including the early vocalizations associated with protophone development (Oller, 2000), including canonical babble, as well as a child's repertoire of speech sounds, syllable shapes, and syllable complexity (Moeller et al., 2007). Differences in vocal development, particularly canonical babble, have been routinely documented between CDHH and children with typical hearing (Ambrose et al., 2016; Iyer & Oller, 2008; Moeller et al., 2007; Oller, 2000). Prolonged delays in canonical babble, and reductions in syllable complexity, have been demonstrated to be predictive of ongoing language delays later in development (Moeller et al., 2007). Vocal development assessments, therefore, have the potential to inform intervention planning and goal setting.

However, monitoring vocal development in the context of complex EHDI systems may be easier said than done. Whether an EHDI program can appropriately collect information about children's vocal development to inform individual service provision rests on an interaction between the types of decisions individual service providers aim to make, the availability of vocal development tests that have sufficient validity evidence to inform these decisions, and whether the tests can be implemented in clinical practice across a program. Certainly, all tests, regardless of the spoken language construct, have limitations with regard to which decisions they are equipped to support (Daub et al., 2021; Daub et al., 2019; Peña, Spaulding & Plante, 2006) and selecting a test requires carefully integrating psychometric evidence with individual decisions

What do SLPs want to know when assessing vocal development in CDHH?

(Daub et al., 2021). The availability of tests that adequately address clinicians' needs is likely to influence whether an EHDI program will be able to successfully implement the test across the program (Daub & Oram Cardy, 2021; Daub et al., 2019). Building interprofessional communities of practice to guide the selection of appropriate outcome monitoring tools has been used in EHDI programs to develop audiological outcome monitoring protocols (Bagatto et al., 2011; 2016; Moodie et al., 2011) and has facilitated wide-spread uptake of the selected tests. While there are several vocal development tests that are commercially available, all have some limitations with regard to the research evidence that is available, and none have been explicitly linked to the assessment purposes that are prioritized by SLPs practicing within an EHDI program (e.g., Ambrose et al., 2016; Cantle Moore, 2014; Cantle Moore & Colyvas, 2018; Keilmann et al., 2018; Kishon-Rabin et al., 2005, 2009; Wachtlin et al., 2017).

There is mounting evidence that tests are misused across the speech-language pathology profession, from basic scientific research (Nitido & Plante, 2020) to clinical practice (e.g., Kerr et al., 2003). Reasons for these misuses have never been systematically explored. One proposal is that there is a disconnect between psychometrics and decision-making across the profession of speech-language pathology (Daub et al., 2021). Daub, Skarakis-Doyle, et al., (2019) hypothesized that including SLPs' perspectives early into the test development process and relating validity evidence to their decision-making could improve commercially available tests and, by consequence of connecting these two processes, improve evidence-informed assessment practice. The authors argued that understanding SLPs' perspectives could lead to not only improved test design, but ultimately improved use and implementation of the test in clinical practice. These predictions were informed by co-productive research practices, which argue for the inclusion of knowledge users (e.g., SLPs, EHDI program managers) as equal partners

What do SLPs want to know when assessing vocal development in CDHH?

throughout the research process (e.g., Graham et al., 2018; Hoekstra et al., 2020; Kothari et al., 2017; Nguyen et al., 2020) to ensure that the resulting research is relevant to, and usable in, the clinical context. The importance of linking test validity evidence to clinical decision-making motivated the current study. It is possible that the clinical decisions SLPs want to make about young CDHH cannot be made (validly) with the currently available vocal development tests. Understanding the clinical decisions that SLPs intend to make using vocal development tests would allow for tailoring test design in a way that maps validity evidence directly onto clinical decision-making and, as a result, facilitate appropriate testing practices in EHDI contexts.

Study Purpose

Our group aims to identify the clinical decisions about vocal development that are important to SLPs who serve CDHH enrolled in EHDI programs. In the present paper, we adopted the position proposed by Daub, Skarakis-Doyle et al. (2019) that a necessary first step in this process was to identify the clinical decisions about vocal development that SLPs identified as most important to their clinical practice. This will enable the future step of mapping the decisions SLPs need to make onto validity evidence of existing vocal development tests (or to develop new evidence or tests), so that tests most appropriate for making the desired clinical decisions can be determined. We expect that by understanding the decisions that are most important to SLPs working in EHDI programs, the results of our work will be useful to (a) inform efforts to conduct new validity investigations of existing vocal development tests, (b) inform design of new vocal development tests intended for EHDI contexts, (c) demonstrate an approach to test design and validation that incorporates SLPs' perspectives, and (d) support the future implementation of vocal development tests into EHDI systems by adopting a co-productive approach to test design (Daub et al., 2019; 2021).

What do SLPs want to know when assessing vocal development in CDHH?

We initiated this study to understand SLPs' vocal development assessment purposes, that is, the clinical decisions they seek to make based on their assessment of early vocal development, as well as barriers to assessment of vocal development that might exist in clinical practice and thus influence the selection of one tool over another. The primary purpose of this study was to identify the assessment purposes that are the highest priorities to SLPs practicing in a Canadian EHDI program, the Ontario Infant Hearing Program (IHP). We expect that understanding SLPs' assessment purposes in this way will enable us to conduct clinically relevant validity projects to support the eventual implementation of new tools into clinical practice as predicted by Daub, Skarakis-Doyle, et al. (2019). Our secondary purpose was to understand the barriers to vocal development assessment of SLPs practicing in the Ontario IHP. Information about the barriers that SLPs experience in assessing vocal development were expected to inform future tool design projects by identifying potential modifications to the tool (e.g., reducing test length if time to assess is considered a major barrier) that would support the clinical uptake of the tool.

We expect that our findings will be of interest to SLPs. First, they are necessary partners in conducting co-productive research. Second, this co-productive approach is the first to illustrate work that incorporates SLP perspectives into the test development process (Daub et al., 2019; 2021), in this case, laying the foundation to link the psychometric evidence underlying vocal development tests to different assessment purposes. We also expect that our findings will be of interest to researchers interested in understanding assessment best practice, because we document a novel approach to co-producing validity evidence and highlight the challenges we encountered in the conduct of this work. Further, this work serves to provide a testable case study of the claims that co-productive approaches to test design can facilitate evidence-informed decision-making (Daub et al., 2019; 2021). Finally, we expect that this work will be of interest to

those involved in EHDI program management by identifying barriers to vocal development

assessment and the assessment purposes prioritized by SLPs in EHDI contexts. For the results of

a vocal development test to be informative within an EHDI system, they must be consistently

and accurately used. Therefore, whether a vocal development test is likely to be adopted by SLPs

is of necessary interest to EHDI programs.

Methods

Ethical Approval

Data collection for this study was completed as part of a larger government Program

Evaluation and Quality Improvement project with the Ontario Ministry of Children, Community

and Social Services that was reviewed by the Western University Research Ethics Board (REB).

The REB considered the project not to be research as described in the Canadian Tri-Council

Policy Statement V.2 (Research Exempt from REB Review, Article 2.4) and therefore it was not

considered to fall under the purview of the REB.

Participants

Survey respondents were SLPs who provide services to CDHH in Ontario's IHP. The IHP

is a publicly funded EHDI program that provides universal newborn hearing screening to all

children in Ontario Canada, and family-centered supports to all children identified with

permanent childhood hearing loss from identification to their transition to school-based services

(typically by the age of 6 years in Ontario). Intervention supports are determined by the family,

and care-plans can include sign-language supports, speech-language pathology services, auditory

verbal therapy, and audiological intervention. Within the Ontario context, CDHH who receive

cochlear implants are managed by a separate program. Therefore, SLPs providing services to

What do SLPs want to know when assessing vocal development in CDHH?

children in the IHP are typically providing services to CDHH with some degree of residual hearing, whose losses may be mild to profound, and who are (often) amplified with hearing aids.

The IHP does not employ its own team of SLPs and before school entry, CDHH in Ontario who are learning spoken language access speech-language pathology services through the Ontario Preschool Speech and Language Program. In the Preschool Speech and Language Program, over 400 SLPs are employed in 29 regions across the province. Whereas the IHP provides services to approximately 11,000 CDHH, SLPs in the Preschool Speech and Language program provide services between birth and school entry to more than 60,000 children with speech, language, or communication needs (e.g., children with developmental language disorder, late talkers, autism, etc.), not just CDHH. Across regions, there are differences in how SLP services are allocated to children enrolled in the Ontario IHP. In some regions, certain SLPs are designated to support all CDHH in that region, whereas in others, any SLP may see a child with permanent hearing loss (along with children with a variety of other needs). Due to the complexities and regional variability in resource allocation, the exact number of SLPs providing services to IHP children across Ontario is unknown. Given this uncertainty, we remain cautious about the generalizability of our findings. IHP management asked the regional coordinators to forward an invitation to participate in the survey to SLPs in their region who provide services to children from the IHP. The survey remained open for a period of three months, and regional coordinators were responsible for reminding their SLPs to complete the survey.

One hundred and two SLPs who provide services to CDHH responded to the online anonymous survey. Of these SLPs, 74 reported having children with permanent hearing loss younger than 22 months on their caseload and were deemed eligible to include in the analyses. Fifty-nine (79.73%) of the eligible surveys contained complete responses. In one instance, a

survey respondent indicated that they did not believe the survey adequately captured their experiences, so data for this respondent were excluded in our analyses. We report the data for a final 58 respondents.

As a group, our participants were highly experienced SLPs and many had advanced training in supporting CDHH. SLPs included in our final analyses had a mean of 16.4 years (*SD*=7.57, range: 3-34 years) of experience working as a SLP and 15.04 (*SD*=7.04, range: 2.5-34) years providing services to children enrolled in the Preschool Speech and Language Program. 34 (59%) SLPs reported that they provide auditory verbal services. The majority of SLPs (74%) had caseloads where less than 25% of the children on their caseloads were CDHH younger than 22 months (see Table 1). Within the program, auditory verbal services may be provided by a certified Auditory Verbal Therapist or by SLPs who have completed additional professional development at a designated IHP training site but are not certified as Auditory Verbal Therapists.

Online Survey

Survey design was informed by The Revised Ottawa Model of Research Use (OMRU; Graham & Logan, 2004). The OMRU is a prescriptive model of implementation science, where implementation interventions are advised to *Assess*, *Monitor*, and *Evaluate* aspects of an evidence-informed innovation, potential adopters, and the practice context (see Supplemental Materials). The survey used in this study (see Supplemental Materials) was conceptualized to *Assess* aspects of the evidence-informed innovation (i.e., clinical decisions that the vocal development tools should be designed to support) as well as aspects of potential adopters (SLPs) and the practice context (publicly funded Infant Hearing and Preschool Speech and Language programs).

What do SLPs want to know when assessing vocal development in CDHH?

      The first survey section consisted of nineteen, 5-point Likert scale questions designed to understand barriers to vocal assessment from the perspective of SLPs (potential adopters) and their practice context using the components of the OMRU as a framework (see Supplemental Materials). This section also contained questions pertaining to barriers to assessing first words and early lexical development in young children. These questions were included because first words are another domain of spoken language that is particularly vulnerable in children with permanent hearing loss (Moeller et al., 2007) and for which there are more commercially available norm-referenced tests (e.g., *MacArthur-Bates Communicative Development Inventories*; Fenson et al., 2007). Asking about first word assessment was expected to highlight barriers to vocal development that may be more pronounced than simply the complexity related to assessing young children. However, barriers related to first words were not our primary focus for analysis. Questions in this section were modelled on surveys originally designed by Moodie and colleagues (2011) to understand pediatric audiologists' perceptions of a new auditory outcome monitoring procedure and then adapted through the lens of the OMRU in order to understand barriers to implementing a spoken language outcome monitoring procedure in a publicly funded EHDI program (Cunningham et al., 2019).

      A second section was dedicated to understanding the assessment decisions that SLPs believe are important to their clinical practice as well as their current assessment practices and barriers to vocal development assessment. We collected data in two ways: first, we attempted to collect responses to six open-ended questions to support a planned secondary concept mapping analysis, and second, we collected quantitative data where SLPs rated the importance of various purposes (see Supplemental Materials). The statement generation section of the survey contained a series of prompts (e.g., "In my clinical practice, I use the results of a child with permanent

hearing loss' vocal development (re)assessment to___") intended to elicit single, full sentence,

statements. However, sorting and interpreting concept mapping statements requires that the

statements contain only one idea and are presented in full sentence form (Kane & Trochim,

2007) – criteria that the statements SLPs provided in their survey responses did not fulfill. For

these reasons, concept mapping of the statements provided by these responses was deemed to be

inappropriate, and the present paper reports the results from the quantitative questions asked in

the next section. Because we were relying on a remote brainstorming process, we were aware

that there was a possibility that the responses SLPs would provide might not conform to the

criteria for concept mapping. To address this concern, we incorporated a second set of questions

about assessment purposes quantitatively.

   In our quantitative questions, we presented SLPs with a list of 15 assessment purposes and

asked them to rate the importance of each purpose on a 5-point Likert scale from "not at all

important" to "very important". The 15 assessment purposes were developed by the first and last

authors who have clinical experience in speech-language pathology (*Author 1* as a student-

clinician, and *Author 3* as a registered SLP). The assessment purposes were intentionally

designed to capture a range of purposes, such as diagnosis, goal setting, and progress monitoring.

During survey design, we speculated that SLPs might reasonably report that all 15 assessment

purposes are important to their clinical practice, which would not support our goal of prioritizing

assessment purposes for future exploration. Therefore, SLPs were also asked to identify 5

assessment purposes that would be the *most* important for a vocal development assessment to be

equipped to answer. Finally, because the 15 statements were generated by the authors and not the

clinicians themselves, we included a final two questions asking respondents to indicate if there

were *other* clinically important assessment questions they have that were not included in our list, and to specify any additional questions they have that were not included.

Analysis

Vocal Development Assessment Purposes

SLPs' 5-point Likert scale ratings of each purpose's importance were evaluated descriptively. Purpose rankings were evaluated with respect to identifying which purposes were flagged the most frequently as belonging in SLPs' "Top 5" assessment purposes. In order to identify whether an assessment purpose was endorsed by the majority of SLPs, we also examined whether any assessment purpose was identified as belonging in more than 50% of SLPs "Top 5".

Barriers to Vocal Development Assessment

Barriers to vocal development were similarly evaluated descriptively. Previous work designed to identify actionable items to target in implementation interventions in EHDI programs pragmatically used a criterion of less than 60% agreement with an item (Cunningham et al., 2019). This criterion was selected as it was felt that 60% or greater corresponded to a reasonable majority and if fewer than 60% of SLPs agreed, this suggested the majority was not in agreement. We initially categorized items as barriers using this 60% criterion (that is, we had less than a majority agreement) and subsequently re-categorized items using a more liberal majority criterion (less than 50% agreement) to determine whether changing criteria would influence our decision-making. All items were positively worded and reverse keying was not required.

<div align="center">

Results

</div>

Assessment Purposes

What do SLPs want to know when assessing vocal development in CDHH?

We considered our 15 pre-developed statements to be representative of clinicians' perspectives if 90% or greater responded 'No' to our question asking if they had any additional purposes not included in the survey. This criterion was established based on percent agreement criteria used in Delphi studies (which typically range between 50-80% agreement to be defined as consensus) and is in line with stricter criteria that have been adopted by researchers working in policy making decisions (i.e., Cunningham, et al., 2019b). Ninety percent (52/54) of clinicians indicated they did not have additional assessment purposes. Participants who indicated they did have additional purposes were asked to list them. One SLP stated they did not have additional assessment questions but provided additional practice context, and one SLP listed a broader question about the availability of vocal development assessments, rather than a clinical assessment purpose. These two 'No' responses were judged by the research team to not represent the SLPs' opinions about our 15 generated statements, and 54/56 (96%) of clinicians had no further questions to add, meeting our criterion of 90%.

Each of the 15 assessment purposes were rated as "Somewhat" or "Very" important by the large majority of SLPs (> 90%; see Table 2) indicating that SLPs approach vocal development assessments with numerous purposes. There was less clarity in which assessment purposes were identified as the most important. All purposes were rated as belonging in some SLPs' "Top 5" assessment purposes (see Table 3). However, only three assessment purposes were prioritized by more than 50% of SLPs: "Does the child's level of vocal development indicate that the child is having more problems with speech development than expected based on their hearing loss?"; "Does the child's level of vocal development indicate the child is having more problems with language learning than expected based on their hearing loss?"; "Has the child acquired new vocal

13

What do SLPs want to know when assessing vocal development in CDHH?

development abilities since their last visit?". Two of these purposes primarily correspond to using tests for differential diagnosis and the third primarily relates to measuring progress.

Barriers to Vocal Assessment

SLPs reported no barriers to the assessment of first words using Cunningham's (2019) conservative definition of a barrier, and in all cases more SLPs agreed or strongly agreed with statements pertaining to first words than they did with statements pertaining to vocal development. The barriers that SLPs report, therefore, appear to be specific to assessing vocal development rather than assessing children younger than 22 months more generally. Three barriers to assessing vocal development were reported using a 60% criterion: two related to economic barriers (whether SLPs had access to the assessment resources they need), and a third relating to knowledge to support interpreting assessment results (see Tables 4-5). In our data, applying a < 50% criterion does not significantly change the interpretation of results. The economic barriers would also meet a more liberal definition of a barrier of < 50% agreement (that is, the majority of SLPs do not agree with the statement). 80% or more of SLPs agreed with all current practice items; 100% of SLPs agreed with items relating to attitude; and 80% or more of SLPs agreed with all cultural/social items. Therefore, no cultural/social, attitudinal, or current practice barriers were reported. That is, SLPs reported that they would value the information from a vocal development assessment and that they believed other professionals (and families) would also be interested in the results. Despite reporting barriers to appropriate assessment tools, the majority of SLPs reported regularly assessing vocal development in children younger than 22 months on their caseload. These results suggest that implementation of new vocal development tools is likely to be unimpeded by SLPs beliefs about whether the results are not relevant or valuable. For researchers interested in tool development, this finding suggests that there is a

14

What do SLPs want to know when assessing vocal development in CDHH?

willingness amongst SLPs to use vocal development tools, and for EHDI programs looking to implement vocal development tools as a part of a spoken language outcome monitoring procedure similarly suggests that SLPs may be willing to adopt the new tests as they are likely to be perceived as relevant to their clinical goals.

Discussion

To our knowledge, this project documents the first effort to incorporate SLPs' perspectives into the process of collecting validity evidence. As an approach, this work marks a shift in how tests can be developed, and validity evidence collected. This project had aimed to identify the assessment purposes that are the *most* important to SLPs providing services to CDHH. All existing vocal development tests have evidence suggesting they are appropriate for some, but not all, assessment purposes. Without an understanding of the decisions SLPs would be using a test to make, we would be unable to make targeted recommendations to the IHP about which test would best fulfill their spoken language outcome monitoring procedure *and* be useful within clinical practice with individual CDHH. Additionally, if we were to recommend a test without knowing the decisions SLPs intend to make, there is a considerable risk of harm. This risk of harm is compounded when we consider implementation at the scale of an entire EHDI program. Specifically, if we recommended a specific test whose psychometrics made it ill-equipped for SLPs' intended decisions, there is a risk of implementing a test that propagates, rather than mitigates, inappropriate decision-making.

We also aimed to identify any barriers to vocal development assessment that would influence future efforts to implement vocal development assessments in EHDI programs broadly as well as the IHP specifically. For the IHP specifically, we were able to identify purposes that any recommended vocal development tool should fulfill (differential diagnosis, measuring,

15

What do SLPs want to know when assessing vocal development in CDHH?

progress, and determining whether children are performing comparable to their hearing peers) to guide future validation work and facilitate developing recommendations for a vocal development assessment that might be appropriate to implement across the program.

Given the variability in assessment purpose prioritization, and the very specific sample of SLPs surveyed, we are unable to identify (a) which assessment purposes are *the* most important to SLPs and (b) whether these priorities are representative of the SLPs practicing in EHDI programs broadly. This is, however, consistent with prior work into SLPs' assessment practices (i.e., Kerr et al., 2003). SLPs in the present study reported that *numerous* assessment purposes (that is, all of the 15 included on the survey) would provide important information for their clinical practice. Furthermore, all assessment purposes were prioritized by some SLPs as a "Top 5" assessment purpose, suggesting that assessment priorities vary from SLP to SLP and likely from client to client. Additionally, the majority of SLPs reported that they do not have the tools they need to appropriately assess vocal development. Knowing which decisions SLPs intend to make, under which circumstances, and with which clinical tools, is necessary to advancing evidence-informed clinical decision-making (Daub et al., 2021) and to developing new, and appropriate, tools to address SLPs' needs. Knowledge about the decisions SLPs will make in clinical practice also supports future implementation efforts by EHDI programs, by enabling programs to select a vocal development test that is best equipped to support the assessment priorities of SLPs in their program, or a test that appropriately balances SLPs' assessment priorities with program evaluation priorities (e.g., Daub & Oram Cardy, 2021). The assessment purposes prioritized by the SLPs call for inherently different sources of validity evidence, study designs, and statistical analyses than those that are commonly reported in norm-referenced test examiner's manuals (see Daub, Skarakis-Doyle, et al., 2019 for a discussion). For example,

16

What do SLPs want to know when assessing vocal development in CDHH?

norm-referenced tests are classically considered ill-equipped for measuring whether children have acquired new skills (e.g., McCauley & Swisher, 1984). However, there are new analyses (e.g., those based in item response theory; Daub et al., 2019) that could support the design of tests for multiple purposes (e.g., determining whether a child is below age-expectations and measuring change in skills) but the analyses are not currently applied in many tests used by SLPs. In sum, documenting the clinical decisions SLPs plan to make, and those decisions that are the most important to their clinical practice, enables researchers to design future studies to demonstrate the effectiveness of specific tests in supporting those clinical decisions as well as clarifying which decisions the test is not equipped to support.

Documenting barriers is similarly expected to inform test and study design to allow tests to fit the clinical contexts in which they will be eventually used. Regardless of the criterion selected to define a barrier, the only barriers that emerged were economic and related to a lack of available assessment tools and resources (e.g., test forms) for conducting a vocal development assessment. In part, the lack of other barriers (e.g., current practice, cultural/social, attitudinal) may reflect the clinical expertise of SLPs who completed our survey. Given the many years of clinical experience as well as advanced training in supporting young CDHH in this particular cohort, we expect that there are likely additional barriers to vocal development assessment across the profession more broadly that were not represented here. In our surveys, we included many possible barriers and assessment purposes. As a result, we were underpowered to evaluate whether experience significantly influenced SLPs' perception of barriers or their assessment priorities. Future evaluations of how experience influences SLPs' assessment priorities would further support the development and adoption of vocal development tests.

Limitations & Future Directions

17

What do SLPs want to know when assessing vocal development in CDHH?

Because our survey contained assessment purposes developed by the research team, it is possible that the present data do not fully represent all the assessment purposes that SLPs might find useful. A mixed-methods design using qualitative interviewing would have ensured our survey fully captured SLPs' perspectives. From there, the themes that emerged from the qualitative interview could have guided the development of a survey to explore generalizability. We did attempt, through the use of concept mapping prompts, to collect SLPs' assessment purposes from their own perspectives, however, we were unable to analyze the statements generated in this survey. Our survey did include questions for asking SLPs to specify any additional decisions that are important to their clinical practice, and the majority indicated that our 15 purposes covered their major purposes. Therefore, we interpret our results as having captured SLPs' *most* important decisions and to be sufficient for developing research priorities. However, by using a survey we were unable to capture the nuanced interpretations that SLPs make using assessment results. Future work using narrative interviews to understand SLPs' clinical decision-making in more depth is expected to also provide rich information about their assessment needs and to be informative to researchers interested in test development. Qualitative methodologies also have the added advantage of facilitating direct communication and relationship-building with SLPs. These relationships could be necessary to inform future co-productive efforts. Future work should consider establishing direct partnerships with SLPs earlier in the process to overcome some of the limitations and challenges we report here. These direct partnerships, where SLPs inform the design of the research question and methodology as well as contribute to the analysis and interpretation of data, including dissemination, are likely to improve upon our methods here and ensure the relevance and utility of the results to the intended knowledge users, namely, SLPs (Graham et al., 2018).

What do SLPs want to know when assessing vocal development in CDHH?

With respect to understanding barriers facing vocal development assessment, our use of surveys also limits the conclusions we can draw. In this work, we used a 60% criterion to define statements as barriers out of a need to guide decision-making. However, there is no evidence that the barriers identified using this criterion are more, or less, influential in future implementation efforts, nor does this criterion allow us to identify for whom the barrier might be greatest. In this way, the use of a survey design limited our ability to fully understand barriers to assessment, as well as SLPs' opinions on how to overcome these barriers. Future work using focus groups or interviewing to expand on the barriers documented in our survey data would provide a deeper understanding of SLPs' practice contexts to researchers looking to develop new vocal development assessments.

Despite these limitations, our work highlights key findings that are of interest to EHDI programs as well as researchers studying vocal development specifically, as well as to researcher's studying evidence-informed assessment practices in speech-language pathology broadly. First, our work reiterates the commercial need for clinically feasible vocal development assessment tools. Despite a lack of appropriate assessment tools, SLPs in our sample reported that information about vocal development is important to not only their clinical practice, but also to the decision-making of other professionals and families of CDHH. SLPs also reported an openness to adopting new tests and using them in their clinical practice. Viewed through the lens of the OMRU, the practice environment and potential adopters, who can dramatically shape the success of implementing a new tool, are supportive of adopting a new tool. In the context of SLPs who work with CDHH in EHDI programs, there do not appear to be attitudinal or organizational barriers to adopting a new test if a suitable one was to become available for them. For EHDI programs, where SLPs may be responsible for accomplishing spoken language

19

outcome monitoring, this work suggests that implementation of a vocal development test into these procedures could be supported by SLPs beliefs that the information from a vocal development assessment is relevant to their clinical practice, in addition to the broader program's needs. Future work in vocal development assessment test design could benefit from incorporating SLP feedback about the tool itself in test design to ensure its successful adoption into clinical practice. This has implications for both researchers and SLPs.

For the broader research community, our work highlights both the assessment purposes that SLPs are likely to make using a vocal development assessment and a methodology for understanding these assessment purposes. Understanding the assessment purposes of those who intend to use them (i.e., SLPs) is one step towards accomplishing a co-productive approach to test design (Daub et al., 2019; 2021) and facilitating the implementation of new vocal development tests in EHDI programs specifically, and new tests within SLPs scope of practice broadly. Although we cannot draw conclusions about the extent to which these priorities generalize to the broader SLP population, we (a) demonstrate the importance of developing tests to fulfill multiple purposes and (b) present a method that can be used to identify assessment priorities to guide tool development and validity studies. As discussed above, these purposes require inherently different validity evidence, and our results provide methodological rationale for researchers designing studies to evaluate the validity evidence for new tools. To our knowledge, this paper is the first in speech-language pathology to document the assessment purposes of SLPs with the intention of incorporating these perspectives into future studies collecting and appraising validity evidence. We expect that using this approach will allow us to adapt new tools so that SLPs perceive them as suitable for clinical practice, as well as providing us with a shared vernacular of assessment purposes with which to discuss these tools with SLPs.

What do SLPs want to know when assessing vocal development in CDHH?

Adopting the perspective of Daub, Skarakis-Doyle, and colleagues (2019), we expect that this approach will support eventual implementation efforts and clinical uptake. For SLPs, preliminary work using co-productive test design approaches is likely to be of interest as a novel approach to test design. As evidence regarding how to conduct co-productive test design projects accumulates, SLPs can identify ways to participate in the test design process. Similarly, SLPs can begin to expect (and insist; Daub et al., 2019) that their perspectives are incorporated into the test design process to facilitate improved testing practices across the profession (Daub et al., 2021).

Conclusions

SLPs reported numerous vocal development assessment purposes as important to their clinical practice. The assessment purposes that were prioritized the highest related to: (a) determining whether a CDHH's vocal development is within age expectations; (b) whether the child has made progress; (c) differential diagnosis; and (d) goal setting. Barriers to vocal development assessment primarily related to a lack of assessment tools. Future work developing and evaluating vocal development assessments according to these purposes are expected to be beneficial to clinical practice.

What do SLPs want to know when assessing vocal development in CDHH?

References

Ambrose, S. E., Thomas, A., & Moeller, M. P. (2016). Assessing vocal development in infants and toddlers who are hard of hearing: A parent-report tool. *Journal of Deaf Studies and Deaf Education*, *21*(3), 237–248. https://doi.org/10.1093/deafed/enw027

Cantle Moore, R. (2014). The Infant Monitor of Vocal Production: Simple beginnings. *Deafness & Education International, 16*(4), 218-236. httpsL//doi.org/10.1179/1464315414Z.00000000067

Cantle Moore, R., & Colyvas, K. (2018). The Infant Monitor of Vocal Production (IMP) normative study: Important foundations. *Deafness & Education International*, 1-17. https://doi.org/10.1080/14643154.2018.1483098

Cunningham, B.J., Daub, O.M., Oram Cardy, J. (2019). Barriers to implementing evidence-based assessment procedures: Perspectives from the front lines in pediatric speech-language pathology. *Journal of Communication Disorders, 80,* 66-80.

Daub, O., Cunningham, B.J., Bagatto, M.P., Johnson, A.M., Kwok, E.Y.L., Smyth, R.E., Oram Cardy, J. (2021). Adopting a conceptual validity framework for testing in speech-language pathology. *American Journal of Speech-Language Pathology, 30(4)*, 1894-1908. https://doi.org/10.1044_2021_AJSLP-20-00032

Daub, O., Oram Cardy, J., Johnson, A.M., Bagatto, M.P. (2019). Validity evidence for the LittlEARS Early Speech Production Questionnaire: An English-Speaking, Canadian Sample. *Journal of Speech, Language, and Hearing Research, 62*(10), 3667-3678. https://doi.org/10.1044/2019_JSLHR-L-18-0411

Daub, O., Skarakis-Doyle, E., Bagatto, M.P., Johnson, A.M., & Oram Cardy, J. (2019). A

comment on test validation: The importance of the clinical perspective. *American Journal*

of Speech-Language Pathology, 28(1), 204-210. https://doi.org/10.1044/2018_AJSLP-18-

0048

Graham, I.D., Kothari, A., McCutcheon, C. *et al.* (2018). Moving knowledge into action for

more effective practice, programmes and policy: Protocol for a research programme on

integrated knowledge translation. *Implementation Science, 13*(22), 1-15.

https://doi.org/10/1186/s13012-017-0700-y

Graham, I.D., Logan, J. (2004). Innovations in knowledge transfer and continuity of care.

Canadian Journal of Nursing Research 36(2), 89-103.

Hoekstra, F., Mrklas, K.J., Khan, M. *et al*. (2020). A review of reviews on principles, strategies,

outcomes and impacts of research partnerships approaches: A first step in synthesising the

research partnership literature. *Health Research Policy Systems, 18*(51). 1-23.

https://doi.org/10.1186/s12961-020-0544-9.

Iyer, S.N., Oller, D.K. (2008). Prelinguistic vocal development in infants with typical hearing

and infants with severe-to-profound hearing loss. *Volta Review, 108*(2), 115-138.

Jansson-Verkasalo, E., Ruusuvirta, T., Huotilainen, M., Alku, P., Kushnerenko, E., Suominen,

K., … Hallman, M. (2010). Atypical perceptual narrowing in prematurely born infants is

associated with compromised language acquisition at 2 years of age. *BMC Neuroscience*,

11, 88. https://doi.org/10.1186/1471-2202-11-88

Johnson, E. K., & Jusczyk, P. W. (2001). Word segmentation by 8-month-olds: When speech cues count more than statistics. *Journal of Memory and Language*, *44*, 548–567. https://doi.org/10.1006/jmla.2000.2755

Kane, M., & Trochim, W.M.K. Concept mapping for planning and evaluation. Thousand Oaks, CA: Sage Publications, Inc; 2007.

Keilmann, A., Friese, B., Lässig, A., Hoffmann, V. (2018). Validation of the second version of the LittlEARS Early Speech Production Questionnaire (LEESPQ) in German-speaking children with normal hearing. *European Archives of Oto-Rhino-Laryngology, 275*(4), 883-888. https://doi.org/10.1007/s00405-018-4889-4

Kerr, A., Guildford, S., & Kay-Raining Bird, E. (2003). Standardized language test use: A Canadian survey. *Journal of Speech-Language Pathology and Audiology*, *27*(1). Retrieved from cjslpa.ca/archive.php

Kishon-Rabin, L., Taitelbaum-Swead, R., Ezrati-Vinacour, R., & Hildesheimer, M. (2005). Prelexical vocalization in normal hearing and hearing-impaired infants before and after cochlear implantation and its relation to early auditory skills. *Ear and Hearing, 26*(Suppl. 4), 17S-29S. https://doi.org/00003446-200508001-00004.

Kishon-Rabin, L., Taitlebaum-Swead, R., & Segal, O. (2009). Prelexical infant scale evaluation: From vocalization to audition in hearing-impaired infants. In L. S. Eisenberg (Ed.), *Clinical management of children with cochlear implants* (pp. 325–368). San Diego, CA: Plural Publishing.

Kothari, A., McCutcheon, C., Graham, I.D., *et al.* (2017). Defining Integrated Knowledge Translation and moving forward: A response to recent commentaries. *International*

Journal of Health Policy Management, *6*(5). 299 – 300.
https://doi.org/10.15171/ijhpm.2017.15

Kuhl, P. K., Conboy, B. T., Coffey-Corina, S., Padden, D., Rivera-Gaxiola, M., & Nelson, T.
(2008). Phonetic learning as a pathway to language: new data and native language magnet
theory expanded (NLM-e). *Philosophical Transactions of the Royal Society of London.
Series B, Biological Sciences*, *363*(1493), 979–1000.
https://doi.org/10.1098/rstb.2007.2154

McCauley, R.R., Swisher, L. (1984). Use and misuse of norm-referenced tests in clinical
assessment: A hypothetical case. *Journal of Speech and Hearing Disorders, 49*, 338-348.

Moeller, M.P. (2000). Early intervention and language development in children who are Deaf
and hard of hearing. *Pediatrics, 106*(3), e43. https://doi.org/10.1542/peds.106.3.e43

Moeller, M. P., Carr, G., Seaver, L., Stredler-Brown, A., & Holzinger, D. (2013). Best practices
in family-centered early intervention for children who are deaf or hard of hearing: An
international consensus statement. *Journal of Deaf Studies and Deaf Education*, *18*(4),
429–445. https://doi.org/10.1093/deafed/ent034

Moeller, M. P., Hoover, B. M., Putman, C. A., Arbataitis, K., Bohnenkamp, G., Peterson, B. et
al. (2007). Vocalizations of infants with hearing loss compared to infants with normal
hearing. Part II: Transition to words. *Ear and Hearing, 28*(5), 628–642.

Moeller, M. P., & Tomblin, J.B. (2015) An introduction to the outcomes of children with hearing
loss study. *Ear and Hearing, 36*, 4s-13s. doi:10.1097/AUD.0000000000000210.

Moodie, S.T., Bagatto, M.P., Miller, L.T., Kothari, A., Seewald, R., & Scollie, S.D. (2011). An
integrated knowledge translation experience: Use of the Network of Pediatric Audiologists

of Canada to facilitate the development of the University of Western Ontario Pediatric

Audiological Monitoring Protocol (UWO PedAMP v.1.0). *Trends in Amplification, 15*(1-

2), 34-56. https://doi.org/10.1177/1084713811417634

Nazzi, T., & Ramus, F. (2003). Perception and acquisition of linguistic rhythm by infants.

Speech Communication, *41*(1), 233–243. https://doi.org/10.1016/S0167-6393(02)00106-1

Nelson, H.D., Bougatsos, C., & Nygren, P. (2008). Universal newborn hearing screening:

systematic review to update the 2001 US Preventive Services Task Force recommendation.

Pediatrics, 122(1), e266-76. https://doi.org/10.1542/peds.2007-1422

Nguyen, T., Graham, I.D., Mrklas, K.J., Bowen, S., Cargo, M., Estabrooks, C.A., Kothari, A.,

Lavis, J., Macaulay, A.C., MacLeod, M., Phipps, D., Ramsden, V.R., Renfrew, M.J.,

Salsberg, J., & Wallerstein, N. (2020). How does integrated knowledge translation (IKT)

compare to other collaborative research approaches to generating and translating

knowledge? Learning from experts in the field. *Health Research Policy and Systems, 18*, 1-

20. https://doi.org/10.1186/s12961-020-0539-6

Oller, D. K. (2000). *The emergence of the speech capacity*. Mahwah, NJ: Lawrence Erlbaum

Associates.

Patel, H., & Feldman, M. (2011). Universal newborn hearing screening. *Paediatric Child Health,*

16(5),1-7.

Peña, E. D., Spaulding, T. J., & Plante, E. (2006). The composition of normative groups and

diagnostic decision making: Shooting ourselves in the foot. *American Journal of Speech-*

Language Pathology, *15*, 247-254. https://doi.org/10.1044/1058-0360(2006/023)

Thiessen, E. D., & Saffran, J. R. (2007). Learning to learn: Infants' acquisition of stress based

strategies for word segmentation. *Language Learning and Development*, *3*(1), 73–100.

https://doi.org/10.1207/s15473341lld0301_3

Tsao, F., M., Liu, H., M., & Kuhl, P. K. (2004). Speech perception in infancy predicts language

development in the second year of life: A longitudinal study. *Child Development*, *75*(4),

1067 1084. doi.org/10.1111/j.1467-8624.2004.00726.x

Wachtlin, B., Brachmaier, J., Amann, E., Hoffmann, V., & Keilmann, A. (2017). Development

and evaluation of the LittlEARS Early Speech Production Questionnaire - LEESPQ.

International Journal of Pediatric Otorhinolaryngology, *94*, 23–29.

https://doi.org/10.1016/j.ijporl.2017.01.007

Werker, J. F., & Tees, R. C. (1984). Cross-language speech perception: Evidence for perceptual

reorganization during the first year of life. *Infant Behavior and Development, 7*(1), 49-63.

https://doi:10.1016/S0163-6383(84)80022-3

Supplemental Material

Supplemental Material: The Revised Ottawa Model of Research Use (Graham & Logan, 2004).

Description: This figure outlines the Revised Ottawa Model of Research Use

This figure is licensed under a Creative Commons Attribution 4.0 License (https://cjnr.archive.mcgill.ca/article/view/1888/1882). No changes have been made to the original image.

What do SLPs want to know when assessing vocal development in CDHH?

Tables

Table 1. Proportion of SLPs' caseloads that include CDHH who are younger than 22 months

	<25%	26-50%	51-75%	>76%	Mode (range)
Number (%) of SLPs	43 (74%)	8 (14%)	0 (0%)	4 (7%)	2 (1-5)

Table 2. SLPs' beliefs about assessment purposes' importance

	Very Unimportant	Somewhat Unimportant	Neutral	Somewhat Important	Very Important	Mode (range)
Is the child's vocal development within age-expectations compared to children their age who are typically developing and have typical hearing?	0 (0%)	3 (5%)	2 (35%)	24 (41%)	29 (50%)	5 (2-5)
Is the child's vocal development within expectations for children with similar levels of hearing loss?	1 (2%)	0 (0%)	6 (10%)	18 (31%)	33 (57%)	5 (1-5)
Is the child's vocal development within expectations for children with similar amplified hearing levels?	0 (0%)	0 (0%)	3 (5%)	18 (31%)	37 (64%)	5 (3-5)
Has the child's vocal development improved, relative to their same-aged peers, since their last visit?	0 (0%)	1 (2%)	5 (9%)	12 (21%)	40 (69%)	5 (2-5)
Has the child acquired new vocal development abilities since their last visit?	0 (0%)	0 (0%)	1 (2%)	6 (10%)	51 (88%)	5 (3-5)

What do SLPs want to know when assessing vocal development in CDHH?

Has the child's vocal development fallen behind their same-aged peers since their last visit?	0 (0%)	0 (0%)	3 (5%)	13 (22%)	42 (72%)	5 (3-5)
Has the child's vocal development plateaued or not changed since their last visit?	0 (0%)	0 (0%)	1 (2%)	7 (12%)	50 (87%)	5 (3-5)
Does the child's level of vocal development indicate the child is having more problems with language learning than expected based on their hearing loss?	0 (0%)	1 (2%)	5 (9%)	15 (26%)	37 (64%)	5 (2-5)
Does the child's level of vocal development indicate that the child is having more problems with speech development than expected based on their hearing loss?	0 (0%)	0 (0%)	2 (3%)	11 (19%)	45 (78%)	5 (3-5)
Does the child's level of vocal development indicate that the child needs more speech and language therapy than they are currently receiving?	0 (0%)	0 (0%)	10 (17%)	16 (28%)	32 (55%)	5 (3-5)
What stage of vocal development has the child mastered?	0 (0%)	0 (0%)	3 (5%)	13 (22%)	42 (72%)	5 (3-5)
What stage of vocal development is emerging?	0 (0%)	0 (0%)	3 (5%)	15 (26%)	40 (69%)	5 (3-5)
What speech sounds would be appropriate goals for the child?	0 (0%)	1 (2%)	2 (3%)	13 (22%)	42 (72%)	5 (2-5)
Which syllable shapes would be appropriate goals for the child?	0 (0%)	0 (0%)	1 (2%)	12 (21%)	45 (78%)	5 (3-5)

What do SLPs want to know when assessing vocal development in CDHH?

Which words would be appropriate goals for the child?	0 (0%)	0 (0%)	4 (7%)	16 (28%)	38 (66%)	5 (3-5)

Table 3. SLPs' prioritization of assessment purposes

Assessment Purposes	In my top 5 (%)	Not in my top 5 (%)
Is the child's vocal development within age-expectations compared to children their age who are typically developing and have typical hearing?	26 (45%)	32 (55%)
Is the child's vocal development within expectations for children with similar levels of hearing loss?	13 (22%)	45 (78%)
Is the child's vocal development within expectations for children with similar amplified hearing levels?	19 (33%)	39 (67%)
Has the child's vocal development improved, relative to their same-aged peers, since their last visit?	12 (21%)	45 (79%)
Has the child acquired new vocal development abilities since their last visit?	37 (64%)	21 (36%)
Has the child's vocal development fallen behind their same-aged peers since their last visit?	10 (17%)	48 (83%)
Has the child's vocal development plateaued or not changed since their last visit?	13 (23%)	45 (77%)
Does the child's level of vocal development indicate the child is having more problems with language learning than expected based on their hearing loss?	29 (50%)	29 (50%)
Does the child's level of vocal development indicate that the child is having more problems with speech development than expected based on their hearing loss?	37 (64%)	21 (36%)

What do SLPs want to know when assessing vocal development in CDHH?

Does the child's level of vocal development indicate that the child needs more speech and language therapy than they are currently receiving?	10 (17%)	48 (82%)
What stage of vocal development has the child mastered?	17 (30%)	41 (70%)
What stage of vocal development is emerging?	19 (33%)	39 (67%)
What speech sounds would be appropriate goals for the child?	21 (36%)	37 (64%)
Which syllable shapes would be appropriate goals for the child?	11 (19%)	47 (81%)
Which words would be appropriate goals for the child?	18 (31%)	40 (69%)

Note: Items in bold are the assessment purposes that SLPs most commonly reported as belonging to their "Top 5" assessment purposes

Table 4. Barriers to Vocal Development Assessment: Potential Adopters

	Potential Adopters					
	Never (%)	Seldom (%)	Sometimes (%)	Frequently (%)	Always (%)	Mode (range)
Current practice						
How often do you assess the vocal development of any child (with or without permanent hearing loss) on your caseload when they are younger than 22 months?	0 (0%)	2 (3%)	6 (10%)	24 (41%)	26 (45%)	5(2-5)
How often do you assess the first words of any child (with or without permanent hearing loss) on your caseload when they are younger than 22 months?	0 (0%)	0 (0%)	2 (3%)	12 (21%)	44 (76%)	5 (3-5)

What do SLPs want to know when assessing vocal development in CDHH?

	Strongly Disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)	Mode (range)
How often do you assess the vocal development of children with permanent hearing loss who are younger than 22 months?	0 (0%)	6 (10%)	4 (7%)	19 (33%)	29 (50%)	5 (2-5)
How often do you assess the first words of children with permanent hearing loss who are younger than 22 months?	0 (0%)	4 (7%)	3 (5%)	7 (12%)	44 (76%)	5 (2-5)
Attitudes						
It is within my scope of practice as a SLP to assess the vocal development of children who have permanent hearing loss who are younger than 22 months	0 (0%)	0 (0%)	0 (0%)	21 (36%)	37 (64%)	5 (4-5)
It is within my scope of practice as a SLP to assess the first words of children who have permanent hearing loss who are younger than 22 months	0 (0%)	0 (0%)	0 (0%)	14 (24%)	44 (76%)	5 (4-5)
Assessing the vocal development of children with permanent hearing loss who are younger than 22 months provides me with important information	0 (0%)	0 (0%)	0 (0%)	24 (41%)	34 (59%)	5 (4-5)
Assessing the vocal development of children with permanent hearing loss who are younger than 22 months provides families with important information	0 (0%)	0 (0%)	3 (5%)	24 (41%)	31 (54%)	5 (3-5)
Assessing the vocal development of children with permanent hearing loss who are younger than 22 months provides audiologists with important information	0 (0%)	0 (0%)	5 (9%)	29 (50%)	24 (41%)	5 (3-5)

What do SLPs want to know when assessing vocal development in CDHH?

Knowledge/skill						
I have the knowledge I need to conduct an appropriate vocal development assessment of a child with permanent hearing loss who is younger than 22 months	1 (2%)	7 (12%)	13 (22%)	29 (50%)	8 (14%)	4 (1-5)
I have the knowledge I need to conduct an appropriate first words assessment of a child with permanent hearing loss who is younger than 22 months	1 (2%)	4 (7%)	8 (14%)	24 (41%)	21 (36%)	4 (1-5)
I have the knowledge I need to appropriately interpret the results of a vocal development assessment of a child with permanent hearing loss who is younger than 22 months	**1 (2%)**	**10 (17%)**	**14 (24%)**	**26 (45%)**	**7 (12%)**	**4 (1-5)**
I have the knowledge I need to appropriately interpret the results of a first words assessment of a child with permanent hearing loss who is younger than 22 months	0 (0%)	5 (9%)	7 (12%)	30 (52%)	16 (27%)	4 (2-5)

Note: Items in bold meet Cunningham's (2019) barriers criteria

Table 5. Barriers to Vocal Development Assessment: Practice Environment

	Practice Environment					
	Strongly Disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)	Mode (range)
Culture/social						

What do SLPs want to know when assessing vocal development in CDHH?

I believe that other SLPs regularly assess the vocal development of children who have permanent hearing loss who are younger than 22 months	0 (0%)	1 (2%)	9 (15%)	30 (52%)	18 (31%)	4 (2-5)
I believe that other SLPs regularly assess the first words of children who have permanent hearing loss who are younger than 22 months	0 (0%)	0 (0%)	4 (7%)	25 (43%)	29 (50%)	5 (3-5)
In my opinion, families of children who have permanent hearing loss who are younger than 22 months want to know about their child's vocal development	0 (0%)	2 (3%)	8 (14%)	30 (52%)	18 (31%)	4 (3-5)
In my opinion, families of children with permanent hearing loss who are younger than 22 months want to know about their child's first words development	0 (0%)	0 (0%)	1 (2%)	22 (38%)	35 (60%)	5 (3-5)
Economic						
In my current practice, I have the assessment tools I need to conduct an appropriate assessment of a child with permanent hearing loss' vocal development before 22 months	**2 (3%)**	**21 (36%)**	**17 (29%)**	**15 (26%)**	**3 (5%)**	**2 (1-5)**
In my current practice, I have the assessment tools I need to conduct an appropriate assessment of a child with permanent hearing loss' first words before 22 months	0 (0%)	8 (14%)	9 (16%)	24 (41%)	17 (29%)	4 (2-5)
In my current practice, I have the time I need to conduct an appropriate assessment of a child with permanent hearing loss' vocal development before 22 months	1 (2%)	5 (9%)	12 (21%)	33 (57%)	7 (12%)	4 (1-5)

What do SLPs want to know when assessing vocal development in CDHH?

In my current practice, I have the time I need to conduct an appropriate assessment of a child with permanent hearing loss' first words before 22 months	1 (2%)	4 (7%)	10 (17%)	34 (59%)	9 (15%)	4 (1-5)
In my current practice, I have the resources (e.g., access to test forms) I need to conduct an appropriate assessment of a child with permanent hearing loss' vocal development before 22 months	**7 (12%)**	**15 (26%)**	**15 (26%)**	**17 (29%)**	**4 (7%)**	**4 (1-5)**
In my current practice, I have the resources (e.g., access to test forms) I need to conduct an appropriate assessment of a child with permanent hearing loss' first words before 22 months	0 (0%)	8 (15%)	8 (14%)	29 (50%)	13 (22%)	4 (2-5)

Note: Items in bold meet Cunningham's (2019) barriers criteria