



University of Utah

UNDERGRADUATE RESEARCH JOURNAL

**SURVEY OF PEDIATRIC AUDIOLOGIST ON THEIR USE OF LOUDNESS
PERCEPTION MEASURES**

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ABSTRACT

The goal of hearing aid fitting is to ensure that low-level sounds are audible, average-level sounds are comfortable, and more intense sounds are loud but not too loud. The uncomfortable loudness level (UCL) threshold helps define the patient's dynamic range, which is used during device fitting. A 2016 survey showed that 67.5% of 350 pediatric audiologist reported to never or rarely measure UCLs with pediatric patients (Moodie et al., 2016). To identify factors influencing this previously-reported limited use of UCL measures, this study surveyed 62 pediatric audiologists in the United States. The questionnaire aimed to improve our understanding of the (non)use of loudness perception measures with pediatric patients and assess familiarity with various loudness perception measurements. In addition, the questionnaire gathered information about the needs of pediatric audiologists in relation to UCL measures. Results show that audiologist report being largely unfamiliar with methods of assessing loudness perception in children, with categorical loudness scaling being the method with which they are most familiar. In addition, audiologist reported being more willing and able to measure uncomfortable loudness levels in older compared to younger pediatric patients. Findings highlight audiologists' need for further information regarding the relevance of loudness perception measurements with pediatric patients.

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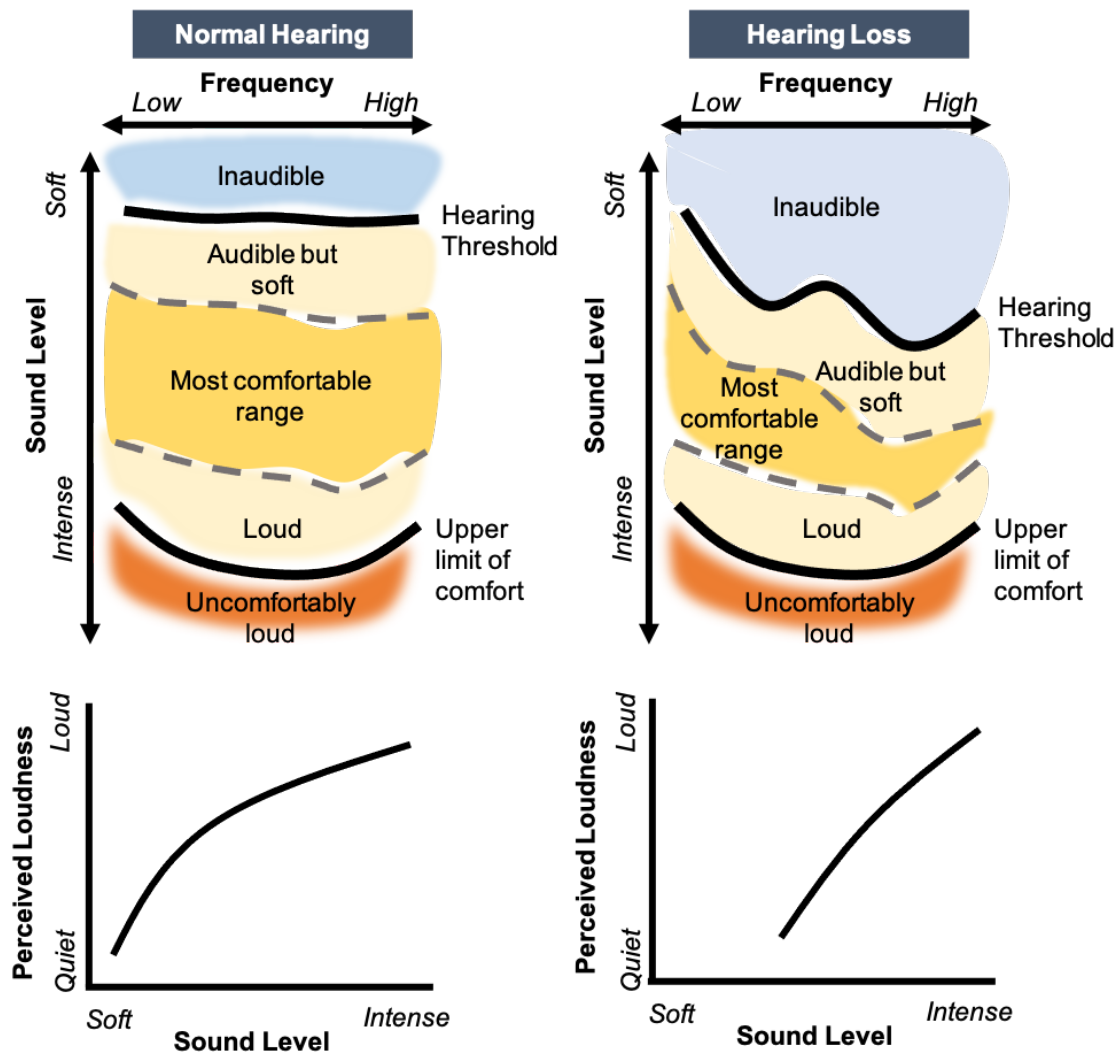
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INTRODUCTION

Loudness is the subjective perceptual strength of a sound ranging from very soft to very loud (Florentine et al., 2011). An individual's 'perception' of loudness can vary from person to person due to a number of factors, such as listener experience, cognitive factors, and stimulus parameters (Evans & Lepore, 1993; Kawell et al., 1988; Kuwano et al., 2003; Serpanos & Gravel, 2000, 2004; Teghtsoonian, 1980). Figure 1 illustrates estimated loudness perception for a listener with normal hearing and a listener with hearing loss for signals at various intensities. Elevated hearing thresholds cause a reduction in a patient's dynamic range, referring to the difference between hearing thresholds and upper limit of comfort. This upper limit of comfort is defined by the patient's uncomfortable loudness level (UCL). Defining the patient's dynamic range can assist the audiologist in normalizing loudness perception. Specifically, ensuring that low-level sounds are audible, average-level sounds are comfortable, and more intense sounds are loud but not too loud. This change in loudness perception as the signal intensity changes is often referred to as loudness growth. The lower panels of Figure 1 illustrate that patients with hearing loss often experience a steeper loudness growth compared to listeners with normal hearing thresholds (Allen et al., 1990; Davidson et al., 2000; Ellis & Wynne, 1999; Florentine et al., 2011; Hodges et al., 1997; Keidser et al., 1999; Marozeau & Florentine, 2007; Serpanos & Gravel, 2000; Wróblewski et al., 2017).

Figure 1.

Schematic of dynamic range



Note. Schematic illustrating the dynamic range of hearing for listeners with normal hearing (top, left panel) and hearing loss (top, right panel). Lower panels illustrate the growth of loudness for listeners with normal hearing and hearing loss.

Measuring Loudness Perception

Methods for measuring loudness perception have evolved over the past 200 years (see Florentine et al., 2011). Due to the subjective nature of loudness, a direct measurement is not available. Several different measurements have been attempted in the quest to develop a well-rounded measurement of loudness. The two contemporary approaches used to measure loudness include equal loudness matching and scaling methods.

During equal loudness matching, a listener is asked to adjust the level of a sound (e.g., pure tone) until the loudness of that sound matches the loudness of another sound (Florentine et al., 2011). It should be noted that this type of measurement does not provide the perceived loudness of a specific sound, but rather is reflective of the listener's ability to perceive a higher-level sound as being louder than a lower-level sound. One test used in clinics that employs the equal loudness matching technique is the Alternate Binaural Loudness Balancing (ABLB) test (Stach, 1998). Audiologists use an ABLB test to measure differences in loudness perception for a listener with unilateral hearing loss. The ABLB test is typically used to understand whether the loudness perception at a particular intensity is the same in both ears when the patient is using different hearing technology across ears (e.g., bimodal patients).

Scaling allows the participant to categorize the sounds they hear along a scale (Florentine et al., 2011; Kawell et al., 1988; Khalfa et al., 2004). Scaling methods are either bounded or unbounded, meaning that they can be contained within a fixed range or not. In addition, the steps between the bounds can be represented by discrete numbers (e.g., 2, 4, 6, 8) or by continuous spacing. Continuous spacing provides an unlimited number of response categories. Both the boundedness and the steps between the bounds—described further below—ultimately affect the stimulus spacing that the listener will hear and number of response categories that the listener can use. These variations in methods for loudness scaling measures influence results by providing researchers with different types of statistical information.

Categorical loudness scaling (CLS) is a bounded and discrete scaling method that is widely used. Listeners are provided with a set of choices in order to categorize or rate a sound they hear, such as 'very soft' or 'loud' (Ellis & Wynne, 1999). CLS can provide clinicians information regarding the patient's UCLs and their loudness growth. This scaling measurement is commonly used in research and clinics (Ching et al., 2010; Crukley & Scollie, 2014; Davidson et al., 2009; Keidser et al., 1999; Kostek et al., 2016; Rasetshwane et al., 2015; Ricketts & Bentler, 1996; Scollie et al., 2010; Wróblewski et al., 2017).

Another scaling method used for measuring loudness is magnitude estimation (Collins & Gescheider, 1989). This is an unbounded, continuous scaling procedure. During magnitude estimation the listener evaluates a series of stimuli presented at randomly-ordered intensity levels. The listener is asked to provide a number that matches the loudness of each stimulus. The opposite of magnitude estimation, another loudness scaling method is magnitude production. During a magnitude production task, the listener is presented with a series of numbers and asked to adjust the intensity of a stimulus by turning a dial until the loudness of the stimulus matches the given numbers (Florentine et al., 2011). In the case of magnitude estimation and production, if the number to which loudness is matched is perceived in a non-auditory modality (e.g., vision), the task is referred to as cross-modality matching. During cross-modality matching, listeners are asked to compare the magnitude of their loudness percept to the magnitude of a percept in

another modality, such as the length of a string. Magnitude estimation, magnitude production, and cross-modality matching all measure a person's perception of loudness in order to provide their loudness growth or function. Gathering any of these measurements will provide a more accurate loudness function for the individual.

Loudness Perception in Children

Most research regarding loudness perception has been conducted using adult participants, leaving a gap in our knowledge of loudness perception in children. The importance of understanding loudness perception in children is apparent when considering that noise in everyday classrooms chronically exceeds recommended limits (American National Standards Institute, 2010; Dockrell & Shield, 2006; Spratford et al., 2019). These loud classrooms can lead to difficult learning environments for children, particularly those with special needs (e.g., hearing loss, autism). With elevated noise levels in daily environments, children experience difficulty with speech perception, requiring increased cognitive effort to successfully listen to their teacher (McGarrigle et al., 2019). This is thought to cause an increase in chronic stress that can ultimately lead to fatigue (Bess et al., 2014). Recent research shows that children with hearing loss experience more fatigue than children without hearing loss (Davis et al., in review; Hornsby et al., 2017). This highlights a necessity to understand how perceptual differences of these loud, noisy environments might contribute to fatigue in children.

There is limited understanding of the developmental trajectory of loudness perception or agreement on measurement methods. Using measures adapted for use with children, children with hearing loss do appear to provide reliable responses on pediatric-adapted loudness scaling measures (Crukley & Scollie, 2012, 2014). A recent research study suggested that children with cochlear implants could be at a higher risk for experiencing discomfort due to their abnormal perception of loudness as compared to their peers with normal hearing (Tak & Yathiraj, 2021). Thus, information obtained using loudness perception measures could provide potentially valuable information to pediatric audiologists; however, research examining appropriate methods for measuring loudness perception in children is plagued by small sample sizes, wide age-ranges of children, and varying methodology (Aazh et al., 2018; Collins & Gescheider, 1989; Ellis & Wynne, 1999; Kawell et al., 1988; Khalfa et al., 2004; Macpherson et al., 1991; Serpanos & Gravel, 2000, 2004; Teghtsoonian, 1980).

Although the use of loudness perception measurements in pediatric patients is thought to be useful for hearing aid fitting and testing for hyperacusis and tinnitus (Aazh et al., 2018; Crukley & Scollie, 2012; Tak & Yathiraj, 2021), the majority of pediatric audiologists do not routinely use these measures (Moodie et al., 2016). In a survey of 350 pediatric audiologists, Moodie et al. found that 67.5% reported to never or rarely measure UCLs with pediatric patients. Reasons cited for never or rarely using this testing included constraints on appointment time and expectations that testing procedures would be challenging for the child. Surprisingly, only 8% of audiologists reported routinely measuring UCLs with pediatric patients. Given the across-listener variability found in adults (Bentler & Cooley, 2001) and the fact that children do not often have the freedom to remove themselves from an environment that is deemed too loud, the role of UCLs in the audiologic management of children is important to consider.

This study sought to describe clinical practice patterns of pediatric audiologists with respect to loudness perception measures. An online survey was created to address questions

regarding the current use of loudness perception measurements with pediatric patients. This survey was intended to improve our understanding of which loudness measurements (if any) are being used clinically and what purpose these measures are serving. Finally, we sought to understand if there are unmet needs of audiologists in relation to measuring loudness perception in children.

Methods

Survey Distribution

Audiologists were recruited via an email invitation submitted to list serves and social media. The invitation included a letter explaining the study, an acknowledgement of informed consent, and a link to the online survey. The invitations were extended on November 16, 2020. The link to the survey was active through December 16, 2020. Participants were eligible if they were licensed to practice audiology in the United States and currently see pediatric patients. This study was approved by the Institutional Review Board at the University of Utah. The responses to this survey were anonymous.

Questionnaire

An online survey was created using the REDCap software (Harris et al., 2009, 2019). The survey was based on a prior assessment of the literature surrounding loudness perception in children and the recent finding that audiologists rarely or never assess UCLs in pediatric patients (Moodie et al., 2016). Audiologists were asked to complete the survey, which was expected to take five to ten minutes to complete. The online survey consisted of two parts: (a) general demographics and (b) a section pertaining to loudness measurements in pediatric patients. Survey respondents self-identified various aspects of their job, including the percentage of pediatric patients seen with sensorineural hearing loss, the highest degree acquired, and the number of years they had been practicing audiology. In addition, they provided information about their current work setting and the specific tasks they perform with their patients. Survey respondents were asked to respond to their potential assessment of UCL in pediatric patients with sensorineural hearing loss. The familiarity with and regularity of use of specific loudness measurements (categorical loudness scaling, cross-modal matching, magnitude estimation/production, and equal loudness matching) was also obtained. Finally, we aimed to describe pediatric audiologists' familiarity with the loudness perception research by assessing respondent agreement with three specific statements: (1) "There is evidence to show that children perceive loudness similarly to adult listeners who have the same audiometric profile," (2) "There is evidence to show that children are able to provide consistent reports of their loudness perception," (3) "There is evidence to show that average data are adequate for estimating UCLs in children." A copy of the survey can be found in the Appendix.

Data Analysis

An excel document was exported from the REDCap survey software and the data were separated using tabs within excel to individually analyze each question. For each survey question, the percentage of respondents selecting the same category (e.g., Always, Almost Never) was calculated. Answers to open-ended questions were analyzed individually to identify common themes.

Reported agreement with the three statements was analyzed using a Friedman's test to determine if the distribution of reported level of agreement differed when considering patients of different ages. Paired comparisons were made using Wilcoxon signed-rank tests when the Friedman's test indicated a significant difference in distributions. A Bonferroni correction for multiple comparisons was used to evaluate the statistical significance of Wilcoxon signed-rank tests - significance was accepted at the $p < .0167$ level.

Results

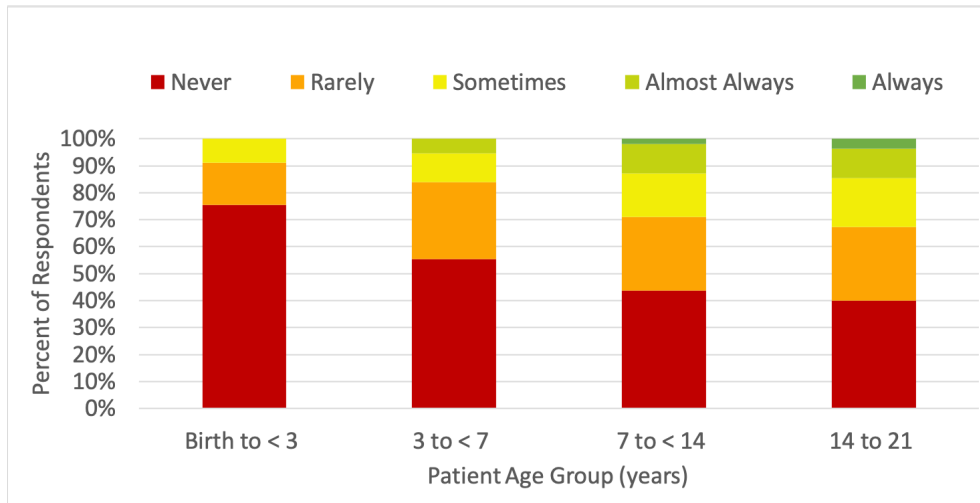
Data were obtained from 62 licensed audiologists who practice in the United States with pediatric patients (≤ 21 years of age). Several survey respondents chose not to answer all questions. For survey questions yielding < 62 responses, sample sizes are reported with the corresponding data. The most common degree held by survey participants was Doctor of Audiology ($n=49$), followed by PhD ($n=9$), and Masters ($n=4$). All but one survey respondent reported more than one year practicing as a licensed audiologist.

Respondents represented a variety of work settings, predominantly hospitals, university clinics, and schools. All survey respondents reported seeing pediatric patients for at least one year. Years of pediatric experience were reported to be 1-5 years by 29% of respondents, 6-10 years by 18% of respondents, 11-20 years by 26% of respondents, and > 20 years by 27% of respondents. Percentage of practice that includes pediatric patients was reported to be $< 40\%$ for 21 respondents and $> 61\%$ for 37 respondents - with one respondent reporting 41-60% of their practice was with pediatric patients. Three respondents did not provide an answer indicating the amount of their practice that includes pediatric patients. Survey respondents were asked to report the percentage of their total practice that includes patients ranging in age from birth to < 3 years, 3 to < 7 years, 7 to < 14 years, and 14-21 years. In general, the majority of survey respondents reported to work with a wide variety of patient ages, with any specific age group comprising $< 61\%$ of their practice. Eight respondents reported that patients aged birth to < 3 years comprised $> 61-100\%$ of their practice. This same percentage of practice was reported by one respondent for patients 14-21 years-old and for four respondents reporting for patients age ranges 3 to < 7 years and 7 to < 14 years (two respondents per age group).

UCL Measurement

Five of the 62 respondents indicated that they were unable or unwilling to answer questions about loudness perception measures, and thus are not included in the survey results pertaining to loudness perception measures. Figure 2 shows the frequency of UCL testing used with pediatric patients of various age groups. As expected, the proportion of respondents who reported to never measure UCLs with their pediatric patients reduces as patient age increases. UCL measures were primarily reported to be used prior to fitting hearing devices (i.e., unaided UCLs during the hearing aid evaluation, to facilitate hearing aid programming) as well as during the fitting process (i.e., adjustment of the hearing aid MPO or mapping of cochlear implants). Several survey respondents reported using UCL testing during the fitting follow-up to evaluate loudness normalization and to troubleshoot issues with loudness sensitivity or intolerance of device. Forty-three respondents rated their level of ease/difficulty when assessing UCLs in patients of varying age groups. Figure 3 shows reported level of ease/difficulty for three patient age groups. As patient age increased, ratings of 'very easy' and 'easy' increased and ratings of 'very difficult' and 'difficult' decreased.

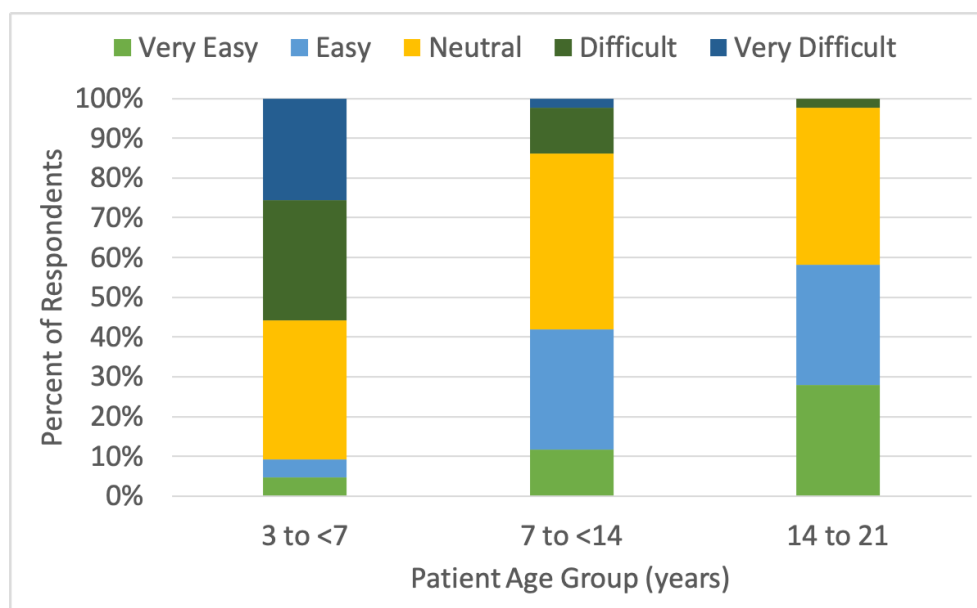
Figure 2.
Frequency of UCL testing



Note. Frequency of use reported for uncomfortable loudness level (UCL) testing with pediatric patients of various age groups.

Figure 3.

Level of ease/difficulty measuring UCLs



Note. Reported level of ease/difficulty when measuring UCLs in pediatric patients of various age groups.

Survey respondents who reported that they never measure UCLs for a particular age group were asked to explain why. When considering patients in the age group of birth to <3 years, survey respondents shared that they mostly believed these children were not old enough for testing or may get upset with the use of loudness measurements. Poor reliability of patient responses was also noted for this age group. When considering patients in the age group of 3 to <7 years, survey respondents reported that patients in this age range were unreliable indicators of their own loudness perception and that UCL testing was of low priority or not useful in their clinical practice. Lastly, audiologists reporting no UCL measurement with patients in the age group of 7 to 21 years commonly disclosed their belief that UCL testing was not useful to their clinical practice, with a handful of respondents noting that they use probe microphone measures to monitor loudness discomfort.

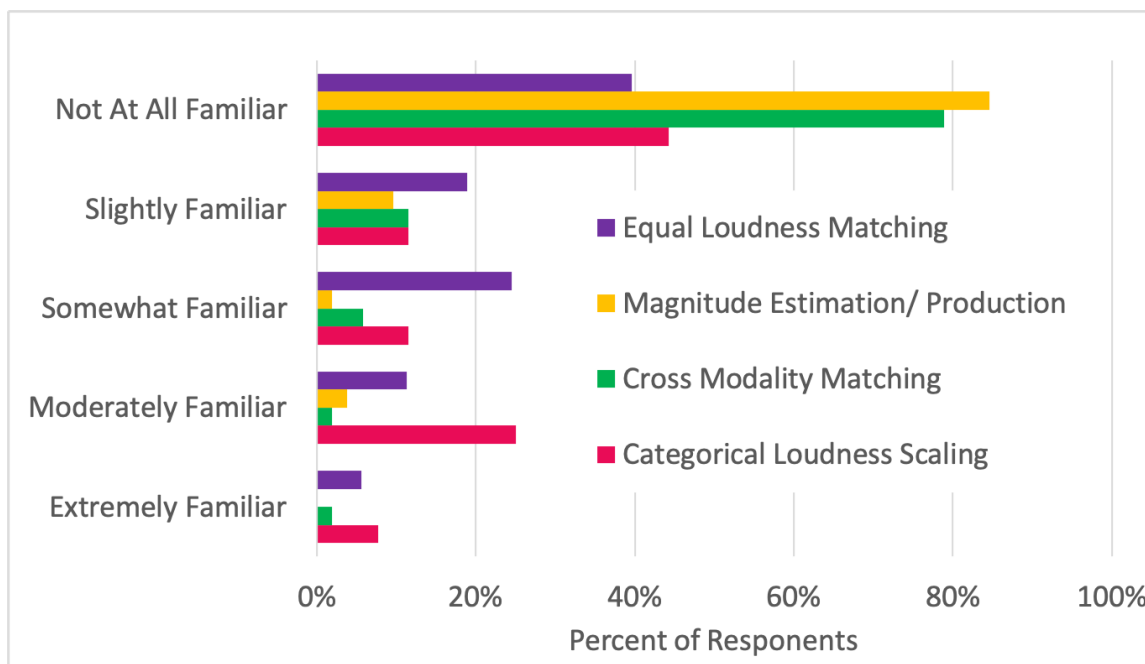
Loudness Perception Measurement Methods

When asked to rate their level of familiarity with loudness perception measurement methods, survey respondents reported being largely unfamiliar with most testing methods. Figure 4 shows the proportion of respondents reporting their level of familiarity with four loudness perception measurement methods used previously with children. Notably, less than 20% of respondents reported being even moderately familiar with methods other than CLS. Despite being the measurement method that respondents reported as most familiar, only 9/56 (16%)

reported to use CLS when measuring UCLs. All nine of these survey respondents reported to use a child-adapted CLS. The number of categories in these child-adapted scales were reported to range from three to nine, with two respondents reporting that the number of categories they use varies based on the skills and age of the patient. Clinicians reported that these child-adapted scales were obtained from cochlear implant manufacturers or that their clinic relies on a physical cue from the patient (e.g., pointing to a stop sign, thumbs down) for category selection. Thirty-two respondents offered explanations for their decision not to use CLS to measure UCLs with their pediatric patients. Of these, lack of familiarity with CLS was the most common (50%), with not seeing the need for or benefit of this test as the next widely-cited reason (28%). Several respondents noted that they use an informal loudness discomfort check (e.g., “When I measure UCLs, I do so more informally by asking them to tell me when it's too loud.”) rather than a formal CLS.

Figure 4.

Familiarity with loudness perception measures



Note. Percent of respondents reporting familiarity with four available loudness perception measures.

Evaluation of Available Evidence

Recall that survey participants were given three statements and were asked to rate their level of agreement with each statement as it pertains to a specific patient age-range. Figure 5 shows the respondents' level of agreement for each statement and age group. In Statement 1, survey respondents evaluated the statement: "There is evidence to show that children perceive loudness similarly to adult listeners who have the same audiometric profile." Variations in agreement with Statement 1 were significantly different across age group ($\chi^2(2) = 6.66, p = .036$). Reported level of agreement with Statement 1 pertaining to patients in the 14 to 21 year age-group was significantly higher than those in the 7 to <14 year group ($z = -2.70, p = .007$) and in the 3 to <7 year group ($z = -2.89, p = .004$). No difference in level of agreement was found when reports evaluating this statement for patients in the two younger groups were compared ($z = -2.058, p = .04$). Notably, the majority of survey respondents reported that they neither agreed or disagreed with this statement when considering all age groups and 24% of participants indicated that they disagreed with the statement that 14 to 21 year-old patients and adults share similar loudness percepts.

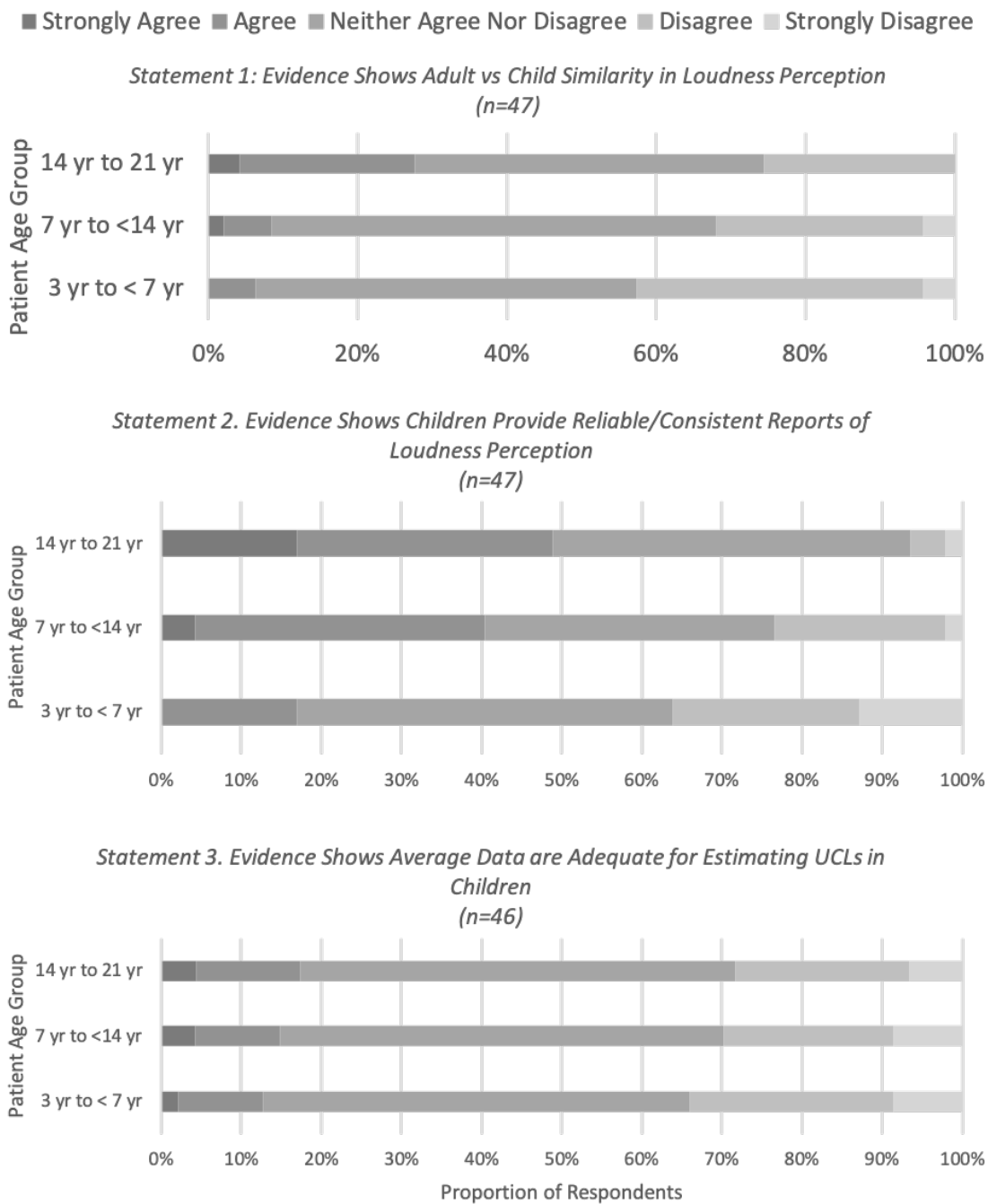
In Statement 2, survey respondents evaluated the statement: "There is evidence to show that children are able to provide consistent reports of their loudness perception." Differences in agreement with Statement 2 were significantly different when considering patients from varying age groups ($\chi^2(2) = 16.28, p < .001$). Level of agreement significantly increased as patient-age increased (3 to <7 years vs 7 to <14 years, $z = -3.015, p = .003$; 3 to <7 years vs 14 to 21 years, $z = -4.185, p < .001$; 7 to <14 years vs 14 to 21 years, $z = -2.678, p = .007$). Despite this increasing agreement that children provide consistent reports of loudness with increasing age, the number of respondents neither agreeing or disagreeing with this statement remained relatively unchanged across patient age-group (34-46%).

Statement 3 asked survey respondents to evaluate their agreement with the following: "There is evidence to show that average data are adequate for estimating UCLs in children." Reported level of agreement with this statement was not different when respondents considered the different age groups ($\chi^2(2) = 2.8, p = .247$). A majority of respondents (53-55%) reported that they neither agree nor disagree with this statement for any age group.

At the end of the survey, participants were asked what features they would enjoy having on a future pediatric measurement of loudness perception. Survey respondents who chose to answer this question ($n = 25$) requested an easy, child-friendly, and time-efficient measurement. Several also noted that the measure should have evidence of reliability in children and of improved patient outcomes with use. Participants were also asked what available resources they wish they had in relation to loudness perception measurement with pediatric patients. Most of the respondents who elected to provide suggestions ($n = 24$) wanted more evidence to support the importance of loudness perception measurements in children and training opportunities to understand this evidence and to increase competence in administering and interpreting the test(s). Several respondents also noted the desire for an objective measure of loudness perception that does not rely on patient cooperation.

Figure 5.

Level of agreement with statements about loudness perception measures



Discussion

The purpose of this study was to use an online survey to highlight specific questions in relation to the clinical use of loudness perception measurements with children. Results replicate the findings from Moodie et al. (2016), showing relatively few pediatric audiologists measure loudness perception in clinic. Our findings provide insight into how clinical practice patterns vary across patient age. Finally, results show this limited use is driven by a lack of familiarity with loudness measures and the belief that loudness perception measures are not useful for clinical practice.

Our results indicate that audiologists practicing in the United States tend to be more willing and able to measure UCLs in old pediatric patients (e.g., 14 to 21 years) than younger ones (e.g., birth to <14 years). This is consistent with their reported beliefs that younger children are unable to provide a reliable response to a subjective loudness measurement. When asked why UCLs are not measured for patients in the youngest group (birth to < 3 years), one respondent reported, “I don't feel this age range could provide an accurate measure of UCL” and another shared, “I am afraid to upset the child as I cannot guarantee they understand the task.” For preschool-age children (3 to < 7 years), one survey respondent noted, “I feel I cannot reliably obtain UCLs in this age range.” Although audiologists report lessened difficulty measuring UCLs as the age of the patient increases (see Figure 3), limited use of UCL measures in older children appear to be due to lack of evidence that this measure improves outcomes. For example, when reflecting on school-age children and adolescents (7 to 21 years), a survey respondent stated that they, “never thought of it or how/why it would be clinically useful.” In sum, the reasons for limited use appear to be different for younger vs older pediatric patients – with audiologists refraining from measuring UCL in young patients due to development-related testing barriers while the choice to not measure UCL in older pediatric patients is due to a lack of perceived importance.

Survey respondents indicated that they had limited familiarity with loudness measurement methods other than CLS (see Figure 4). This lack of familiarity suggests that pediatric audiologists may not receive adequate education or training regarding various loudness perception measurements. Despite the evidence and clinical relevance of using loudness measurements with adult participants (Shi et al., 2007), audiologist report being unfamiliar with loudness perception measures and unsure of their clinical relevance to their pediatric practice. Consistent with Moodie et al. (2016), where 67.5% of respondents within the survey reported to rarely or never measure LDLs (UCLs), 62-84% of the current survey respondents said that they rarely or never measure UCLs in their pediatric patients. Once again, a lack of familiarity was cited amongst audiologist as a reason why they choose not to use CLS to measure a patient's UCLs. This highlights a gap from research to practice, as several studies of loudness perception in children use a form of CLS (Cruckley & Scollie, 2012, 2014; Davidson et al., 2000, 2009; Israelsson et al., 1995; Scollie et al., 2010; Van Eeckhoutte Maaik et al., 2020; Wolfe et al., 2015).

To further evaluate respondents' use (or not) of loudness perception measurements, three statements were rated for relative agreement/disagreement. For statement 1, “There is evidence to show that children perceive loudness similarly to adult listeners who have the same audiometric profile,” audiologists were more likely to agree that research has shown similar

loudness perception in adults and children ages 14-21 years than children of younger age groups. This might suggest that audiologists believe loudness perception undergoes a prolonged developmental period extending until adolescence. There is no evidence to support this belief, as previous studies highlight that children of 5 years of age or older have similar responses on loudness perception measures when compared to adults, particularly for studies measuring UCLs (Ellis & Wynne, 1999; Kawell et al., 1988; Macpherson et al., 1991). Agreement with statement 2, “There is evidence to show that children are able to provide consistent reports of their loudness perception,” also increased with the age of the patient. Although this finding seems to suggest that audiologists are aware of research illustrating improved reliability of loudness perception measures across development, a significant portion of respondents (36-47%) selected that they ‘neither agree nor disagree’ with this statement. This is likely indicative of the lack of current research on loudness perception in children. Reported agreement with statement 3, “There is evidence to show that average data are adequate for estimating UCLs in children,” indicated that the majority of survey respondents (53-55%) neither agreed nor disagreed with this statement regardless of patient age group. This suggests that respondents are unsure if they should use average UCLs for children or if they should measure them using loudness measures.

Across the audiologists surveyed in this study, clinical practice patterns for loudness perception measures vary widely, with the majority of use with older children. The question of clinical relevance and concern with administration appear as dominating factors motivating the low use with pediatric patients. Considering that several respondents noted their desire for more research in this area, low use of loudness perception measures among pediatric audiologist could be due to a paucity of literature exploring loudness perception in children. A further examination into the relevance of loudness perception measurements used with pediatric patients should be considered. If loudness perception measures are found to improve outcomes of pediatric patients, there is a need for increased training regarding the purpose and method of loudness perception measurement before audiologists will routinely conduct these measurements with their pediatric patients.

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Appendix REDCap Survey

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Page 1

Loudness Perception in Children

Please complete the survey below.

Thank you!

Are you currently licensed to practice Audiology in the United States of America? Yes
 No

This survey is intended to collect clinical practice information only from Audiologists who work in the United States. We appreciate your willingness to participate. Have a great day!

In your practice, do you currently see pediatric patients (< 21 years)? Yes
 No

This survey is intended to collect clinical practice information only from Audiologists who see pediatric patients. We appreciate your willingness to participate. Have a great day!

What percentage of your practice includes the following age patients?

	0-20%	21-40%	41-60%	61-80%	81-100%
Birth to < 3 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3 years to < 7 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7 years to < 14 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14 years to 21 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What percentage of your practice involves working with children who have permanent sensorineural hearing loss?



Highest degree completed (please choose one): Masters
 Doctor of Audiology
 PhD
 Other (please specify)

Please specify your highest degree completed.

How many years have you been practicing as an Audiologist (please choose one): Less than 1 year
 1-5 years
 6 to 10 years
 11 to 20 years
 20+ years

How many years have you been seeing pediatric patients (please choose one): Less than 1 year
 1-5 years
 6 to 10 years
 11 to 20 years
 20+ years

Please choose all terms that describe your current pediatric audiology work setting:

- Private Practice - owner/employee
 Hospital
 College/University Clinic
 ENT Office
 Multidisciplinary Medical Clinic
 Department/Warehouse Store
 School
 Other (please specify)

Please specify your current pediatric audiology work setting.

Please choose all that apply. In my practice I...

- Perform diagnostic hearing evaluations (including ABR)
 Prescribe and fit hearing aids
 Evaluate candidacy for cochlear implants
 Program cochlear implants
 Perform Central Auditory Processing Disorder (CAPD) evaluations
 Perform evaluations of the vestibular system
 Other (please specify)

Please specify any other tasks you perform in your practice.

The following questions pertain to loudness perception measures.

- Yes
 No

Note that we are using the term uncomfortable loudness level (UCL) to refer to a frequency specific measure of loudness discomfort that is measured in an audiometric booth.

Additionally, within the following section of the questionnaire, the term 'children' will refer to children with permanent sensorineural hearing loss. When comparing child vs adult, we are referring to children and adults who share the same audiometric profile.

I understand the definitions used within this survey for UCL and 'children' and am ready for the next set of questions.

How often do you assess UCLs in your pediatric patients?

	Always	Almost Always	Sometimes	Rarely	Never
Birth to < 3 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3 years to < 7 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7 years to < 14 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14 years to 21 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please describe why you never assess UCLs in ages birth to < 3 years?

Please describe why you never assess UCLs in ages 3 to < 7 years?

Please describe why you never assess UCLs in ages 7 to < 14 years?

Please describe why you never assess UCLs in ages 14 to 21 years?

When (if) you measure UCLs for children with permanent sensorineural hearing loss, for what purpose is it (please choose all that apply)?

- Pre-fitting/during the hearing evaluation: to determine unaided UCLs
 Pre-fitting: to facilitate hearing aid programming
 During fitting: to adjust amplification MPO
 During fitting: to MAP cochlear implant current
 Post fitting: to evaluate loudness normalization
 Other (please specify)

Please specify any other purpose you measure UCLs.

	Not At All Familiar	Slightly Familiar	Somewhat Familiar	Moderately Familiar	Extremely Familiar
Please rate your level of familiarity with Categorical Loudness Scaling (CLS)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you use CLS to measure UCLs in your pediatric patients?

- Yes
 No

Please describe why you do not use CLS to measure UCLs in your pediatric patients. Also note whether other methods are used and please describe these methods.

How many categories are on your CLS measure used with pediatric patients? Please choose one.

- 1
 2
 3
 4
 5
 6
 7
 8
 9
 10
 Other (please specify)

Please specify the number of categories you/your clinic uses.

Do you use a child-adapted categorical loudness scale?

- Yes
 No

Did your clinic make the adaptations to the CLS?

- Yes
 No

Please identify the scale you/your clinic adapted and describe those adaptations.

Which categorical loudness scale do you/your clinic use?

Do you use a published categorical loudness scale that has not been adapted for child use with your pediatric patients?

Yes
 No

You've indicated that you use a published categorical loudness scale that has not been adapted for use with children. Please note which scale(s) you use with your pediatric patients.

You've indicated that you use a custom (non-published) categorical loudness scale that has not been adapted for use with children. Please describe the scale you use with your pediatric patients who have permanent sensorineural hearing loss.

Please rate how easy/difficult you find measuring UCLs in children with permanent sensorineural hearing loss.

	Very Easy	Easy	Neutral	Difficult	Very Difficult
3 years to < 7 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7 years to < 14 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14 years to 21 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please rate your familiarity with the following methods that have previously been used to measure loudness perception?

	Not At All Familiar	Slightly Familiar	Somewhat Familiar	Moderately Familiar	Extremely Familiar
Categorical Loudness Scaling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cross Modality Matching	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Magnitude Estimation/Production	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Equal Loudness Matching	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please note your level of agreement with the following three statements.

"There is evidence to show that children perceive loudness similarly to adult listeners who have the same audiometric profile."

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
3 years to < 7 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7 years to < 14 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14 years to 21 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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"There is evidence to show that children are able to provide consistent reports of their loudness perception."					
	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
3 years to < 7 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7 years to < 14 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14 years to 21 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

"There is evidence to show that average data are adequate for estimating UCLs in children."					
	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
3 years to < 7 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7 years to < 14 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14 years to 21 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If methods other than CLS were available, what features would this pediatric measurement need to have in order for you to use it?

What do you wish you had available to you re: loudness perception for clinic use with children?
