SUPPLEMENTAL VIDEOS FOR THE INFANT-TODDLER MEANINGFUL AUDITORY INTEGRATION SCALE

By Brittan A. Barker[1], Hannah D. Jones[1], and Chelsi G. Daquanno[2]

The Infant-Toddler Meaningful Auditory Integration Scale (IT-MAIS) is used to assess auditory development in young children with hearing loss. Despite being widely used, previous research showed that its psychometric properties are not ideal. As a first step toward psychometric advancements of the IT-MAIS, this study aimed to create videos with strong content validity that can later be used to supplement the IT-MAIS questions and ultimately improve its reliability. Researchers first surveyed 10 pediatric audiologists to determine how representative 6 different video scripts were of their corresponding IT-MAIS questions. Researchers then filmed the top-rated scripts. Finally, researchers surveyed an additional 25 pediatric audiologists and 25 caregivers unfamiliar with the IT-MAIS to assess the videos' content validity. Analyses showed that the audiologists and caregivers agreed on which video best depicted each of the 10 IT-MAIS questions, thus suggesting that the videos had strong content validity.

INTRODUCTION

The pediatric cochlear implant (CI) candidacy evaluation for very young children includes a battery of tests to ensure medical and audiometric suitability. The Infant-Toddler Meaningful Auditory Integration Scale (IT-MAIS; Zimmerman-Phillips, Osberger, & Robbins, 2001) is a caregiver-report tool often included in this battery. Specifically, the IT-MAIS is used to assess and monitor functional listening pre- and post-CI in children aged 0 to 3 years who have sensorineural hearing loss. Despite the fact that the IT-MAIS is the most frequently administered caregiver-report questionnaire by pediatric CI professionals in the

[1] Utah State University; [2] Louisiana State University. Correspondence concerning this manuscript may be addressed to Dr. Barker at brittan.barker@usu.edu.

United States (Uhler & Gifford, 2014), little research has examined its validity and reliability. Furthermore, recent evidence suggests the IT-MAIS' psychometric properties are not ideal (Barker, Donovan, Schubert, & Walker, 2017). This study proposes that supplementing the IT-MAIS questions with videos would help illustrate the questions, subsequently improving both its intra- and inter-rater reliability and strengthening the overall psychometric properties of the IT-MAIS. This content validation study is a first step toward such improvements in reliability. Specifically, researchers created high-quality videos to accompany the IT-MAIS and engaged expert pediatric audiologists and parents with no knowledge of hearing loss to assess the videos' content validity.

Pediatric CI clinical and research programs use the IT-MAIS to help determine CI candidacy and track listening development post-implantation (e.g., Barker, Kenworthy, & Walker, 2011; Cardon & Sharma, 2013). The IT-MAIS is a criterion-referenced assessment that evolved from the Meaningful Auditory Integration Scale (MAIS; Robbins, Renshaw, & Berry, 1991). The IT-MAIS includes 10 questions developed to measure a child's ability to: vocalize, alert to sounds, and derive meaning from sound (Zimmerman-Phillips et al., 2001). Via interview format, an experienced pediatric audiologist elicits responses from a caregiver about aspects of their child's auditory development. The caregiver's responses are then rated on a 0–4 Likert scale reflecting the frequency of the child's behavior (0/never, 1/rarely, 2/occasionally, 3/frequently, 4/always).

IT-MAIS STANDARDIZATION

Construct validity and internal consistency reliability are essential psychometric properties for assessment measures like the IT-MAIS (Frost et al., 2007; Haynes, Richard, & Kubany, 1995). Construct validity is the extent to which an assessment measures what it is intended to measure. For very young children with hearing loss, it is particularly important to make sure assessments are measuring the skills they are believed to measure because important intervention decisions (e.g., should the child be fit with hearing aids or undergo CI surgery) are based on the assessments' outcomes. Intra- and inter-rater reliability are also essential psychometric properties of assessment measures. Each rater needs to consistently use the assessment measure in a way that ensures

the skills being assessed are accurately represented by the measure. Intra- and inter-rater reliability must be established before assessing its construct validity.

To date there is little research available regarding the psychometric properties of the IT-MAIS, thus making it difficult for researchers and clinicians to make informed decisions about using the IT-MAIS in their laboratories and clinics. The first to explore the IT-MAIS' psychometric properties were the assessment's authors. In their study, Zimmerman-Phillips, Robbins, and Osberger (2000) administered the IT-MAIS to the caregivers of nine infants pre-CI and 3 months post-CI. The researchers noted an increase in scores across patients when comparing pre- and post-CI scores, though the increases were minor in this small sample size. The authors interpreted the increase in IT-MAIS scores to indicate progress in auditory development resulting from CI intervention. Zheng and colleagues (2009) also analyzed the validity of the IT-MAIS and showed that many of the infants reached the upper limit of performance on one or more of the IT-MAIS questions before they were 24 months of age. Furthermore, their results have limited external validity because the researchers used a sample population of Mandarin-speaking children with typical hearing thresholds, as opposed to children with hearing loss, the IT-MAIS' intended population.

Most recently Barker and colleagues (2017) used Rasch analysis to examine pre- and post-CI IT-MAIS data from 23 CI users, aged 10 to 36 months. Overall, they demonstrated that the IT-MAIS' psychometric properties are weak and suggested that the IT-MAIS should be modified in an attempt to improve the psychometric properties. Specifically, in their work, Rasch analysis of eight IT-MAIS questions showed that caregivers did not use the rating scale reliably and that there was a large floor effect. Barker and colleagues hypothesized that the unpredictable responses from caregivers may have occurred because the IT-MAIS questions are poorly worded, are not relevant to what the caregivers experience with their children, or that variation in administration styles lead to inconsistent responses. Among other things Barker and colleagues called for was a revision of the IT-MAIS (in particular, rewording existing questions) in hopes of improving administration consistency. They proposed that standardizing administration would subsequently improve the psychometric properties, in particular its intra- and inter-rater reliability.

Improving the IT-MAIS

Even though the IT-MAIS may not be psychometrically ideal, it continues to be frequently used in clinic and laboratory settings. In 2014, Uhler and Gifford conducted a survey with audiologists across the United States about pediatric CI candidacy evaluations and programming. The survey data revealed that the IT-MAIS was the most frequently administered parent report measure in CI clinics throughout the United States. The IT-MAIS' clinical popularity may be due in part to the fact that the assessment is a U.S. Food and Drug Administration (FDA) labeled indication for children younger than 3 years old receiving the Advanced Bionics' HiResolution CI device (United States Food and Drug Administration's Ear, Nose, and Throat Devices Panel of the Medical Devices Advisory Committee, 2015, May 1). In other words, IT-MAIS administration is required by the FDA for any young children scheduled to receive an Advanced Bionics' HiResolution CI device.

The IT-MAIS is also frequently used in clinical research. As of February 2018, a keyword search for "Infant-Toddler Meaningful Auditory Integration Scale" in MedLine, ERIC, and PsychInfo yielded a total of 78 English language articles from academic journals dated from 2000 to 2018. In these articles, researchers primarily used the IT-MAIS to track the auditory development of children with different types and degrees of hearing loss. For example, Osberger, Zimmerman-Phillips, and Koch (2002) used the IT-MAIS to determine if age of implantation affected post-CI benefit in 90 children. The post-CI scores showed that children receiving CIs before 2 years of age had significantly higher IT-MAIS scores than those receiving CIs between 2 and 3 years of age. Peterson and colleagues (2013) used the IT-MAIS, among other tests, to compare improvements in listening skills post-CI in 10 children with auditory neuropathy and 10 without auditory neuropathy. Despite the fact that each of these studies used the IT-MAIS as its primary measurement, their results must be interpreted with caution and cannot be soundly implemented into clinical practice given that the assessment's psychometric properties are less than ideal (Barker et al., 2017).

If researchers focus on improving the psychometric properties of the IT-MAIS, the assessment would yield data that is more representative of a child's true auditory function. Ensuring that the results from the IT-MAIS are psychometrically sound is crucial because decisions regarding CI surgery and additional care are based on these results (e.g., Barker et

al., 2015). Sound data are also crucial in research, specifically when the IT-MAIS is being used to compare the auditory development of children in different habilitation programs, which determines the programs' efficacy. One step toward improving the utility of the IT-MAIS would be to focus on improving intra-rater reliability (i.e. ensure caregivers consistently respond to the IT-MAIS questions over time), as suggested by Barker and colleagues (2017). Recall that they hypothesized that inconsistent administration lead to unpredictable caregiver responses, which is the reason for the low intra-rater reliability of the IT-MAIS. Thus, it stands to reason, if researchers could improve administration and response reliability, they may subsequently improve intra-rater reliability—a first step toward strengthening the overall psychometric properties of the IT-MAIS and improving the results' validity.

One method used in healthcare to improve information retention and inter-rater reliability is the addition of videos when training professionals tasked with rating patient behavior and counseling pediatric patients' parents. This practice is known as video supplementation and it is used often in healthcare settings. For example, Lyden and colleagues (1994) used video supplementation to train professionals tasked with rating behaviors of patients who suffered strokes. In their study they used two videos to train the professionals to accurately rate behaviors. Each video consisted of stroke patients engaged in various tasks of daily living. The Modified National Institutes of Health Stroke Scale Summary (mNIHSS; Lyden, Lu, Levine, Brott, & Broderick, 2001) was paired with the videos and used for rating the patients' behaviors. The mNIHSS consists of 15 items where the rater can give the patient a score from 0 to 4. Training success was measured via the number of outliers for each professional on the mNIHSS. The results ultimately showed that 85% of professionals that viewed the video had < 5 outliers during their video evaluation of the first set of patients and 91% of professionals had < 5 outliers on their video evaluation of the second set of patients. These data suggested that the use of video supplementation is an effective tool for training physicians to use the mNIHSS.

Researchers also used video supplementation during genetic counseling with families (Temme et al., 2015). In their study Temme and colleagues tested whether or not incorporating a 4-minute video into genetic counseling sessions would help pediatric patients' parents retain information presented by the healthcare professional. Data analyses

showed that all families retained information over a 6-week period, but families that viewed the video supplements retained significantly more information than those without video support. In other words, parents provided with video supplementation seemed to better understand and retain results of the genetic testing longer than those families who underwent genetic counseling without the videos.

Taken together, these studies demonstrate that video supplementation in healthcare settings can improve information retention and inter-rater reliability—both improvements that could strengthen the IT-MAIS. For this study, researchers drew from the aforementioned research (Temme et al., 2015) to create video supplementation with strong content validity for each IT-MAIS question. The authors propose that such videos will be crucial for future research aimed toward improving the intra-rater reliability of the IT-MAIS.

PHASE I: VIDEO SCRIPT DEVELOPMENT

The present study consisted of three phases. In Phase I, the authors created six video scripts for each of the 10 IT-MAIS questions. Experienced pediatric audiologists then determined which scripts were most representative of each IT-MAIS question.

Methods

Participants. A convenience sample of 10 certified pediatric audiologists participated in Phase I. Inclusion criteria were as follows: each audiologist self-reported to (1) be a certified audiologist in accordance with American Speech-Language-Hearing Association's (ASHA) requirements; (2) be in possession of accurate, maintained, and up-to-date licensure; (3) have a minimum of 5 years of in-field experience as a pediatric audiologist; (4) be a native English speaker; and (5) have no uncorrected hearing and/or vision problems.

Stimuli. Six representative video scripts for each IT-MAIS question ($N = 60$) were generated by eight individuals with knowledge of pediatric listening development. Each script illustrated the auditory behavior targeted in the specific IT-MAIS question and was eligible for filming. Three videos were described from a subjective point of view (i.e., the caregiver's point of view) and three were from an objective point of view.

Each script was approximately two to three sentences in length (Risse & Kliegl, 2011) and involved no more than four main characters: a child (approximately 30 months old), a second and third child, and an adult caregiver.

Survey and apparatus. The internet-based software SurveyMonkey Pro (2014) was used to collect data for Phase I. SurveyMonkey is an online service that allows individuals to create surveys, collect responses, and analyze results. The survey consisted of 10 questions.

For this Phase, each survey question (i.e. "How representative is each of the following video scenarios of the question") and its corresponding IT-MAIS question were presented at the top of the participant's screen. Six video scripts were listed below the question. After reading a script, the participant used a Likert scale to indicate how representative the script was of the corresponding IT-MAIS question. The Likert scale's anchors were as follows: 7 = the script was most representative of the question and 1 = the script was least representative of the question (see Figure 1 for a screen shot of the survey). For each participant, the questions were presented randomly without repetition during the survey.

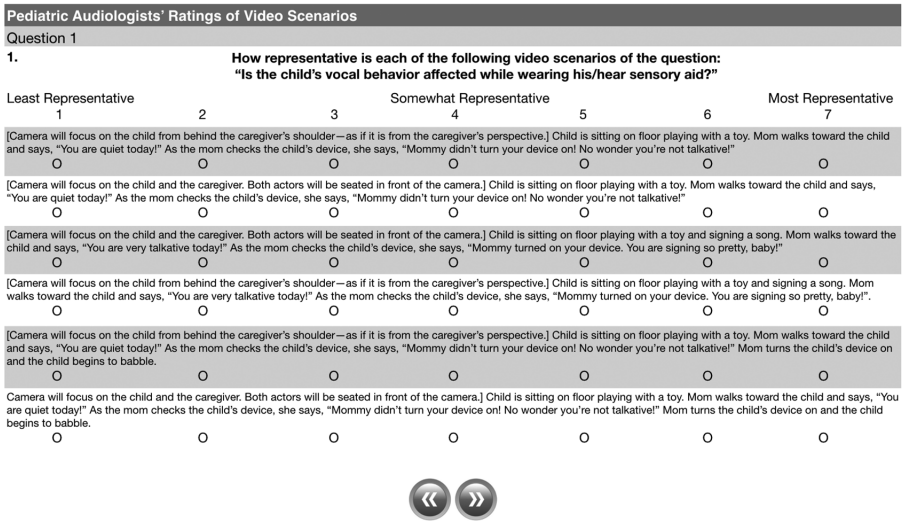

Figure 1. Screen shot of Phase I's SurveyMonkey survey for IT-MAIS question 1.

Procedure. Participants completed the survey online via SurveyMonkey on their personal computers. To begin, each eligible audiologist was emailed the survey link. Individuals who agreed to

participate provided informed consent by clicking on the survey link. After clicking on the email's survey link, the survey opened in the audiologist's web browser. The survey's welcome screen informed the individual about the survey's purpose and the 7-point Likert scale used to rate each video script. After reading the instructions, the participant clicked the "next" button at the bottom of the screen and navigated through the survey. All data were saved anonymously; no IP numbers were stored.

Results

Mean scores (*M*) were calculated for each script using the data gathered from SurveyMonkey (Table 1). Mean scores indicated which video scripts were deemed to be most representative by pediatric audiologists, and the two scripts with the highest mean scores were identified as the most representative of each IT-MAIS question. The top two scripts ratings for each of the 10 IT-MAIS questions ranged from *M* = 4.40 – 6.50 (with a score of 7 being the most representative).

Table 1. Pediatric audiologists' *M* ratings (*N* = 10) for each video script (*N* = 6) and its accompanying IT-MAIS question. The gray fields show the 2 top-rated scripts. These scripts were filmed in Phase II and rated using a 7-point Likert scale with the following anchors: 1 = the script was least representative of the question and 7 = the script was most representative of the question.

IT-MAIS Question (Zimmerman-Phillips et al., 2001)	Video Script	*M* Rating
1. *Is the child's vocal behavior affected while wearing his/her sensory aid?*	1	3.50
	2	3.10
	3	6.20
	4	4.00
	5	3.50
	6	6.10
2. *Does the child produce well-formed syllables and syllable sequences that are recognized as "speech"?*	1	4.20
	2	5.30
	3	5.90
	4	4.30
	5	3.43
	6	6.10
3. *Does the child spontaneously respond to his/her name in quiet with auditory cues only (no visual cues)?*	1	3.90
	2	3.90
	3	5.80
	4	4.30
	5	4.00
	6	6.20

IT-MAIS Question (Zimmerman-Phillips et al., 2001)	Video Script	*M* Rating
4. *Does the child spontaneously respond to his/her name in the presence of background noise with auditory cues only (no visual cues)?*	1	4.40
	2	4.20
	3	3.40
	4	5.20
	5	4.10
	6	3.67
5. *Does the child spontaneously alert to environmental sounds in the home without being told or prompted to do so?*	1	5.30
	2	5.80
	3	3.50
	4	5.10
	5	5.70
	6	3.33
6. *Does the child spontaneously alert to environmental sounds in new environments?*	*1*	*6.40*
	2	4.40
	3	3.40
	4	6.50
	5	4.30
	6	3.40
7. *Does the child RECOGNIZE auditory signals that are part of his/her everyday routines?*	*1*	*4.00*
	2	6.20
	3	4.50
	4	4.10
	5	6.30
	6	4.60
8. *Does the child demonstrate the ability to discriminate spontaneously between two speakers with auditory cues only (i.e. no visual cues)?*	1	3.70
	2	6.30
	3	4.20
	4	3.80
	5	5.30
	6	4.20
9. *Does the child spontaneously know the difference between speech and non-speech stimuli with listening alone?*	1	4.00
	2	4.20
	3	6.30
	4	3.90
	5	4.40
	6	6.50
10. *Does the child spontaneously associate vocal tone (anger, excitement, anxiety) with its meaning, based on hearing alone?*	1	3.10
	2	3.50
	3	4.90
	4	3.30
	5	4.60
	6	5.40

PHASE II: DEVELOPMENT OF SUPPLEMENTAL VIDEOS

In Phase II, the top two scripts for each IT-MAIS question from Phase I were filmed and edited. The videos' content validity was then assessed based on ratings gathered from experienced pediatric audiologists and parents unfamiliar with pediatric hearing loss.

Methods

Participants. A total of 50 people participated in this phase. Twenty-five pediatric audiologists and 25 caregivers unfamiliar with the IT-MAIS completed the Phase II survey. Pediatric audiologists were recruited through a convenience sampling method using email correspondence. Potential participant email addresses were collected via the American Auditory Society's directory, nationwide pediatric audiology clinic websites, state early hearing detection and intervention (EHDI) coordinators, and snowball recruiting. Participating audiologists reported that they: (1) had current state licensure; (2) were a pediatric audiologist; and (3) had at least two years of experience as an audiologist. Twenty-five caregivers of typically developing children aged 0–36 months who had no experience with the IT-MAIS were recruited from social media, email, and snowball recruiting. Participating caregivers reported being a parent of at least one child who was 36 months old or younger at the time they participated in the study.

Video stimuli. The two most-representative video scripts, as determined by audiologists from Phase I (see Table 1), were filmed and edited. Some of these video scripts were modified to better represent their corresponding IT-MAIS question and facilitate filming (e.g., instead of using a toy that makes noise to capture the child's attention as originally planned, a ringing cell phone was used). Families from the community volunteered to help with filming in natural environments. Each video was edited using Adobe Premier CC (2015) software. The 20 final videos ranged in duration from 4 s to 26 s. After video editing, the final 720p mpg-formatted videos were uploaded to the Qualtrics (2016) online survey software site.

Survey and apparatus. Videos were filmed with support from Utah State University's Media Production using a Panasonic GH4 camera with a 12 mm Rokinon lens, a Panasonic HC-V77K camera, and a GoPro 4. A Sennheiser 3 lapel microphone was used for audio recording. After

filming, the videos were uploaded to an iMac desktop computer running OS 10.11. The videos were edited with Adobe Premier CC (2015) and Final Cut Pro X (Version 2015) computer software. Audio editing was done using Adobe Audition (2015) computer software.

The internet-based software Qualtrics (2016) was used to collect data for Phase II. Qualtrics is another online service that allows individuals to create surveys, collect responses, and analyze results.

The survey consisted of demographic questions (four for audiologists; two for caregivers) and 20 questions, one for each video. Similarly to Phase I, participants rated the representativeness of the two videos filmed for each of the 10 IT-MAIS questions using a 7-point Likert scale with the following anchors: 1 = the script was least representative of the question and 7 = the script was most representative of the question (see Figure 2 for a screen shot of the survey).

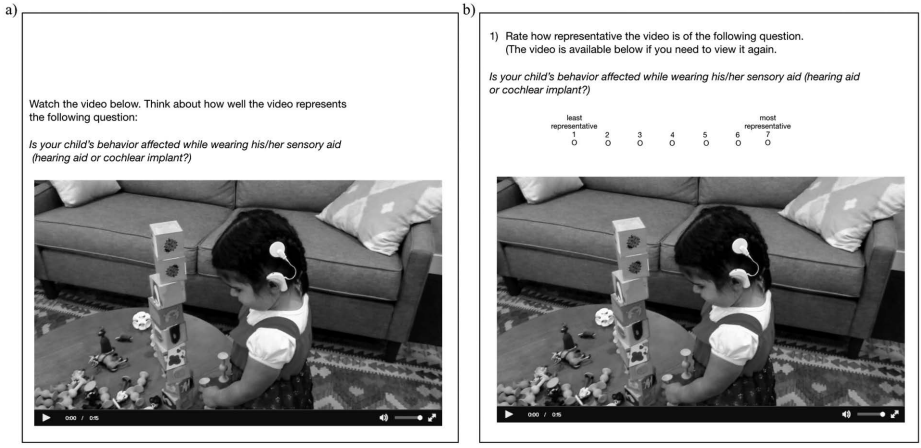

Figure 2. Screen shots from Phase II of the Qualtrics survey. Image (a) illustrates what a participant saw during their first exposure to the video and corresponding IT-MAIS question. Image (b) illustrates the additional Likert scale available to the participant after clicking the next button following their first exposure to the video and corresponding IT-MAIS question.

Procedure. Participants completed the survey online via Qualtrics on their personal computers. Each eligible participant was emailed the survey link with instructions. Once an interested individual clicked on the survey link, the survey opened in their web browser. The consent form appeared on their screen first. The person then read the consent form and indicated whether or not they agreed to participate via a button

click. If they chose not to participate, the survey ended.

If the individual agreed to participate, a welcome page appeared in their internet browser's window. This page included instructions and a description of the rating scale the participants would be using to rate each of the video's representativeness to its corresponding IT-MAIS question. Following the instructions, the participant was presented with demographic questions. If a participant's responses to the demographic questions suggested that they did not meet the study's inclusion criteria, the survey ended. If the participant met inclusion criteria, the next page to appear in their internet browser reviewed the rating task instructions and then the video rating task began.

For Phase II, each survey question (i.e. participant instructions: "Watch the video below…", the embedded video, and its corresponding IT-MAIS question) appeared in the internet browser's window simultaneously. The participant's initial job was to view the video and click the next button. After clicking next, the 7-point Likert scale appeared on the screen. (See Figure 2 for a screen shot of the survey used in Phase II.) After the participant rated the video for representativeness of the IT-MAIS question, the next survey question appeared, and they navigated through the remainder of the survey. Participants could skip any videos/questions at any point in the survey. After the participant completed the survey, the final screen displayed a message thanking them for their participation. All data were saved anonymously; no IP numbers were stored.

Results

The *M* score ratings for each video across audiologists and across caregivers were calculated and are displayed in Table 2. Ratings for each video ranged from $M = 1.80 – 6.72$. When comparing the video pairs for each question, the video with the highest *M* rating was deemed the video that best represented the corresponding IT-MAIS question. Pediatric audiologists and caregivers agreed as to which videos were most representative for eight of the 10 IT-MAIS questions. However, in order to have psychometrically sound videos able to supplement the IT-MAIS questions in the future, all of the corresponding videos must have strong content validity—i.e., each video must accurately represent the intent of its corresponding IT-MAIS question. Because the data showed that the audiologists and caregivers only agreed on representativeness of

eight of the 10 videos, it was necessary to repeat the video development process for IT-MAIS questions 9 and 10.

Table 2. Pediatric audiologists' *M* ratings (*N* = 25) and caregivers' *M* ratings (*N* = 25) for each video script (*N* = 2) and their accompanying IT-MAIS question. The dark gray fields show the top-rated script. Ratings were based on a 7-point Likert scale with the following anchors: 1 = the script was least representative of the question and 7 = the script was most representative of the question. Note, audiologists and caregivers did not agree on videos for questions 9 and 10 (as indicated by light gray highlighting).

IT-MAIS Question (Zimmerman-Phillips et al., 2001)	Video Script	Pediatric Audiologists' *M* Ratings	Caregivers' *M* Ratings
1. *Is the child's vocal behavior affected while wearing his/her sensory aid (hearing aid or cochlear implant)?*	3	4.29	4.68
	6	6.00	5.36
2. *Does the child produce well-formed syllables and syllable sequences that are recognized as "speech"?*	3	3.13	3.12
	6	4.12	4.60
3. *Does the child spontaneously respond to his/her name in quiet with auditory cues only (no visual cues)?*	3	5.56	5.68
	6	6.63	5.96
4. *Does the child spontaneously respond to his/her name in the presence of background noise with auditory cues only (no visual cues)?*	1	4.96	5.12
	4	6.68	6.64
5. *Does the child spontaneously alert to environmental sounds in the home without being told or prompted to do so?*	2	1.80	2.28
	5	4.24	3.96
6. *Does the child spontaneously alert to environmental sounds in new environments?*	1	6.0	6.16
	4	5.56	5.28
7. *Does the child RECOGNIZE auditory signals that are part of his/her everyday routines?*	2	5.48	5.52
	5	6.72	6.52
8. *Does the child demonstrate the ability to discriminate spontaneously between two speakers with auditory cues only (i.e., no visual cues)?*	2	4.60	4.50
	5	6.40	6.16
9. *Does the child spontaneously know the difference between speech and non-speech stimuli with listening alone?*	3	4.44	4.48
	6	4.96	4.32
10. *Does the child spontaneously associate vocal tone (anger, excitement, anxiety) with its meaning based on hearing alone?*	3	3.72	4.28
	6	3.88	3.60

PHASE III: DEVELOPMENT OF SUPPLEMENTAL VIDEOS FOR IT-MAIS QUESTIONS 9 AND 10

In order to develop new scripts and videos for IT-MAIS questions 9 and 10, the authors replicated the original video development process.

Methods

Phase III was a replication of Phases I and II. First, six video scripts for IT-MAIS questions 9 and 10 were created. Ten pediatric audiologists were then surveyed via Qualtrics (2016) and asked to rate how representative each video script was of its corresponding IT-MAIS question on a Likert scale with 1 = least representative and 7 = most representative. Next, the *M* ratings of the six written scripts were calculated for both questions (see Table 3); ratings ranged from *M* = 3.40 – 5.90. The *M* ratings were then used to determine which two written scripts were deemed most representative by pediatric audiologists for question 9 and 10.

Table 3. Pediatric audiologists' *M* ratings (*N* = 10) for each video script (*N* = 6) and its accompanying IT-MAIS question. The gray fields show the two top-rated scripts. These scripts were filmed in Phase III and rated using a 7-point Likert scale with the following anchors: 1 = the script was least representative of the question and 7 = the script was most representative of the question.

IT-MAIS Question (Zimmerman-Phillips et al., 2001)	Video Script	*M* Rating
9. Does the child spontaneously know the difference between while wearing his/her sensory aid?	1	5.60
	2	3.40
	3	4.10
	4	5.80
	5	3.80
	6	4.60
10. Does the child spontaneously associate vocal tone (anger, excitement, anxiety) with its meaning based on hearing alone?	1	5.60
	2	4.70
	3	4.90
	4	5.90
	5	4.60
	6	5.30

The two, top-rated scripts were then filmed. As in Phase II, these videos were filmed and edited with the support of Utah State University's Media Production and their same equipment. The four new videos were embedded into a Qualtrics (2016) online survey. This survey was

formatted in the same way as the video survey used in Phase II. Finally, a total of 50 new participants took the survey, 25 pediatric audiologists and 25 caregivers unfamiliar with the IT-MAIS, rated the representativeness of the videos using the same Likert scale where 1 = least representative and 7 = most representative.

Results

The *M* ratings for all videos were calculated across both groups of raters (Table 4). *M* ratings for each video ranged from *M* = 4.73 – 5.84. When comparing the video pairs for question 9 and 10, the video with the highest *M* rating was deemed the video that best represented the corresponding IT-MAIS question. Pediatric audiologists and caregivers agreed as to which videos were most representative of IT-MAIS questions 9 and 10. Thus, taken together, the results of Phase II and III indicated that both audiologists and caregivers agreed on which videos were most representative of each of the 10 IT-MAIS questions.

Table 4. Pediatric audiologists' *M* ratings (*N* = 25) and caregivers' *M* ratings (*N* = 25) for each video script (*N* = 2) and their accompanying IT-MAIS question. The gray fields show the top-rated script. Ratings were based on a 7-point Likert scale with the following anchors: 1 = the script was least representative of the question and 7 = the script was most representative of the question.

IT-MAIS Question (Zimmerman-Phillips et al., 2001)	Video Script	Pediatric Audiologists' *M* Ratings	Caregivers' *M* Ratings
1. *Does the child spontaneously know the difference between speech and non-speech stimuli with listening alone?*	1	4.84	4.73
	4	5.84	5.55
2. *Does the child produce well-formed syllables and syllable sequences that are recognized as "speech"?*	1	5.08	4.94
	4	5.72	5.06

DISCUSSION

The IT-MAIS is often used in clinics and laboratories across the world (e.g., Osberger et al., 2002; Peterson et al., 2013; Uhler & Gifford, 2014). However, in their recent longitudinal study, Barker and colleagues (2017) showed that caregivers did not predictably respond to items from the IT-MAIS. Such unpredictable caregiver responses to the IT-MAIS' items lower the overall psychometrical soundness of the assessment—specifically its caregiver reliability. The present study was a first step toward the end-goal of improving the reliability of caregivers' responses

to the IT-MAIS items. The authors proposed that video supplementation is a viable tool for improving the IT-MAIS' intra-rater reliability. However, before determining if video supplementation indeed improves the IT-MAIS' intra-rater reliability, one must first develop videos with strong content validity. The goal of the present study was to develop said videos.

The present study took place across three phases. First, 10 pediatric audiologists were surveyed to determine how representative six different video scripts were of their corresponding IT-MAIS questions. Next, the top-rated scripts were filmed. Finally, an additional 25 pediatric audiologists and 25 caregivers unfamiliar with the IT-MAIS were surveyed to assess the videos' content validity. Analyses showed that the audiologists and caregivers agreed on which video best depicted each of the 10 IT-MAIS questions, thus suggesting that the videos had strong content validity. In other words, the data gathered from audiologists and caregivers in the present study showed that the videos developed within are relevant to and representative of the targeted auditory behaviors targeted by the IT-MAIS. These data from the present study are notable given that the content validity of the supplemental videos will affect the caregivers' future interpretations of the IT-MAIS questions that will be made from these supplemental videos (Haynes et al., 1995).

Limitations

As with all research, the present study has limitations. The present study is limited in that the efforts to focus on the IT-MAIS may be outdated. Despite what the aforementioned research from Uhler and Gifford (2014) suggested, pediatric audiologists' self-report that they do not rely on the IT-MAIS as a bedrock for pediatric CI evaluation. Consequently, researchers might consider expanding on Uhler and Gifford's initial study and gathering an updated count of frequent IT-MAIS users. It is possible that since their initial data collection, the number of clinicians using the IT-MAIS in their assessments of pediatric CI candidates/users has dwindled.

Future Directions

In concert with Barker and colleagues' (2017) suggestions, the next step toward improving the IT-MAIS is to incorporate video supplementation into IT-MAIS administration and assess the enhanced

tool's validity and reliability. Based on the aforementioned work that explored video supplementation in a healthcare setting (Lyden et al., 1994; Temme et al., 2015), the authors hypothesize that video supplementation would improve the IT-MAIS' intra- and inter-rater reliability and subsequently its criterion and construct validity. Such improvements to the psychometric properties of the IT-MAIS is crucial since intervention decisions continue to be made based on the IT-MAIS' results (e.g., Cardon & Sharma, 2013). Strong psychometric properties are also important in research settings where auditory development is tracked to assess outcomes of various aural (re)habilitation interventions (e.g., Barnard et al., 2015).

CONCLUSION

In this content validation study, videos were created that corresponded to each of the 10 IT-MAIS questions. Experts (pediatric audiologists) and non-experts (caregivers) were surveyed and the results demonstrated that each video has strong content validity and accurately depicts its corresponding IT-MAIS question. The development of these videos was the first step toward improving the psychometric properties of the IT-MAIS. The next step is to employ these videos in conjunction with IT-MAIS administration and determine if the video supplementation facilitates caregiver responses' and subsequently improves the IT-MAIS' intra-rater reliability.

ACKNOWLEDGEMENTS

We are grateful to Meghan and Thomas Call's family along with Caydee and Alex Meibos' family for volunteering as actors in our videos. We would also like to thank Utah State University's Media Production (especially, Dave Evans) for their help with video filming and editing.

REFERENCES

Adobe Audition CC (Version 8) [Computer software]. (2015). San Jose, CA: Adobe Systems.

Adobe Premier (Version 5) [Computer software]. (2015). San Jose, CA: Adobe Systems.

Barker, B. A., Donovan, N. J., Schubert, A. D., & Walker, E. A. (2017).

Using rasch analysis to examine the item-level psychometrics of the infant-toddler meaningful auditory integration scales. *Speech, Language and Hearing, 20*, 130–143. https://doi.org/10.1080/2050571X.2016.1243747

Barker, B. A., Kenworthy, M. H., & Walker, E. A. (2011). How we do it: Employment of listening-development criteria during assessment of infants who use cochlear implants. *Cochlear Implants International, 12*, 57–59. https://doi.org/10.1179/146701010X486543

Barnard, J., Fisher, L., Johnson, K., Eisenberg, L., Wang, N., Quittner, A., … The CDaCI Investigative Team. (2015). A prospective, longitudinal study of US children unable to achieve open-set speech recognition five years after cochlear implantation. *Otology & Neurotology, 36*, 985–992. https://doi.org/10.1097/MAO.0000000000000723

Cardon, G., & Sharma, A. (2013). Central auditory maturation and behavioral outcome in children with auditory neuropathy spectrum disorder who use cochlear implants. *International Journal of Audiology, 52*, 577–586. https://doi.org/10.3109/14992027.2013.799786

Frost, M. H., Reeve, B. B., Liepa, A. M., Stauffer, J. W., Hays, R. D., & Sloan, J. A. (2007). What is sufficient evidence for the reliability and validity of patient-reported outcome measures? *Value in Health, 10*, 94–105. https://doi.org/10.1111/j.1524-4733.2007.00272.x

Haynes, S. N., Richard, D. C. S., & Kubany, E. S. (1995). Content validity in psychological assessment: A functional approach to concepts and methods. *Psychological Assessment, 7*, 238–247.

Lyden, P. D., Brott, T., Tilley, B., Welch, K. M. A., Mascha, E. J., Levine, S., . . . Marler, J. (1994). Improved reliability of the NIH stroke scale using video training. *Stroke, 25*, 2220–2226. https://doi.org/10.1161/01.STR.25.11.2220

Lyden, P. D., Lu, M., Levine, S. R., Brott, T. G., & Broderick, J. (2001). A modified national institutes of health stroke scale for use in stroke clinical trials: Preliminary reliability and validity. *Stroke, 32*, 1310–1317. https://doi.org/10.1161/01.STR.32.6.1310

Osberger, M. J., Zimmerman-Phillips, S., & Koch, D. B. (2002). Cochlear implant candidacy and performance trends in children. *Annals of Otolaryngology, Rhinology, and Laryngology, 111*, 62–65. https://doi.org/10.1177/00034894021110S513

Peterson, A., Shallop, J., Driscoll, C., Breneman, A., Babb, J., Stoeckel, R., & Fabry, L. (2013). Outcomes of cochlear implantation in children

with auditory neuropathy. *Journal of the American Academy of Audiology, 14*, 188–201. https://doi.org/10.1097/MAO.0b013e3182877741

Qualtrics [Computer software]. (2016). Provo, UT: Qualtrics. Retrieved from www.qualtrics.com.

Risse, S., & Kliegl, R. (2011). Adult age differences in the perceptual span during reading. *Psychology and Aging, 26*, 451–460. https://doi.org/10.1037/a0021616

Robbins, A. M., Renshaw, J. J., & Berry, S. W. (1991). Evaluating meaningful auditory integration in profoundly hearing-impaired children. *The American Journal of Otology, 12*, 144–150.

SurveyMonkey (Pro Version) [Computer software]. (2014). San Mateo, CA: SurveyMonkey, Inc. Retrieved from www.surveymonkey.com.

Temme, R., Gruber, A., Johnson, M., Read, L., Lu, Y., & McNamara, J. (2015). Assessment of parental understanding of positive newborn screening results and carrier status for cystic fibrosis with the use of a short educational video. *Journal of Genetic Counseling, 24*, 473–481. https://doi.org/10.1007/s10897-014-9767-7

Uhler, K., & Gifford, R. H. (2014). Current trends in pediatric cochlear implant candidate selection and postoperative follow-up. *American Journal of Audiology, 23*, 309–325. https://doi.org/10.1044/2014_AJA-13-0067

United States Food and Drug Administration's Ear, Nose, and Throat Devices Panel of the Medical Devices Advisory Committee. (2015, May 1). *FDA executive summary: Premarket to postmarket shift in clinical data requirements for cochlear implant device approvals in pediatric patients*. Washington, DC: FDA.

Zheng, Y., Soli, S. D., Wang, K., Meng, J., Meng, Z., Xu, K., & Tao, Y. (2009). A normative study of early prelingual auditory development. *Audiology & Neuro-Otology, 14*, 214–222. https://doi.org/10.1159/000189264

Zimmerman-Phillips, S., Osberger, M. J., & Robbins, A. M. (2001). *Infant-toddler meaningful auditory integration scale*. Sylmar, CA: Advanced Bionics Corporation.

Zimmerman-Phillips, S., Robbins, A. M., & Osberger, M. J. (2000). Assessing cochlear implant benefit in very young children. *Annals of Otology, Rhinology, & Laryngology - Supplement, 185*, 42–43.