

Social Validity of Technology Assisted Spoken Language Intervention for Children who are Deaf and Hard-of-Hearing

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Abstract

Children who are Deaf or Hard-of-Hearing (DHH) are at-risk for language delays and associated developmental challenges that impact academic, social, and communication skills. Technology Assisted Language Intervention (TALI) is a novel approach that focuses on using augmentative and alternative communication (AAC) as an intervention for children who are DHH. Results from a recent pilot study suggested that TALI may be a viable approach for enhancing spoken language and communication. In this study, we examined the social validity of TALI using interviews and focus groups. We collected qualitative data from parents, caregivers, and professionals working with children who are DHH to gain their perspectives on the feasibility of TALI outside of formal therapy (e.g., school, home, community) and as a supplement to existing spoken and sign language interventions. Participants' responses were documented through written and audio recordings, and qualitative analysis of focus groups was conducted by researchers in a consensus approach. Parents/caregivers reported that TALI was feasible to implement in home and therapy settings, while professionals suggested that TALI may enhance reading and writing curricula. Professionals also reported that implementing TALI may be challenging to incorporate into manual or total communication academic settings. Overall, results suggest that TALI is a promising, socially valid, supplementary intervention for children who are DHH and communicate primarily through spoken language.

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Acronyms: AAC = augmentative and alternative communication; ASL = American Sign Language; AVT = auditory-verbal therapy; CCN = Complex Communication Needs; CI = cochlear implant; DDI = data-driven instruction; DHH = deaf or hard of hearing; EHDl = Early Hearing Detection and Intervention; EI = Early Intervention; GLA = Group Level Assessment; ImPAACT = Improving Partner Applications of Augmentative Communication Techniques; LSL = listening and spoken language; NVIQ = nonverbal IQ; SGD = speech generating device; SLP = speech language pathologist; TALI = Technology Assisted Language Intervention

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Children who are Deaf or Hard-of-Hearing (DHH) often face challenges in making age-appropriate gains in communication skills despite remarkable system-based

improvements in Early Hearing Detection and Identification (EHDl) programs and provision of Early Intervention (EI; Tomblin, Harrison, Ambrose, Walker, Oleson, & Moeller,

2015). There has been a lack of focus on evolving and alternative treatment methods to support spoken language development, especially in school-aged children who have graduated from EI programs. We applied a well-accepted treatment modality for language intervention in complex and multiply involved populations, known as augmentative and alternative communication (AAC), to children who are DHH. Our initial study (Meinzen-Derr, Wiley, McAuley, Smith, & Grether, 2016) developed a novel application of AAC, termed Technology Assisted Language Intervention (TALI) to supplement speech-language therapy with children who are DHH. In that study, five children with bilateral permanent hearing loss and language underperformance (defined as a gap between the language standard score and the nonverbal IQ [NVIQ] standard score) participated in a 24-week structured program using TouchChat WordPower on iPads. The length of the children's utterances increased significantly, the number of different words they spoke per language sample increased, and their conversational turn lengths also increased. The successful therapy results led us to investigate practical feasibility and social validity of TALI intervention for application at home and in school settings. Therefore, this qualitative study was designed to examine the social validity of TALI as a communication tool in children who are DHH.

Language Outcomes of Children Who Are DHH

Communication skills are of utmost importance in children identified as DHH to assure full access to education and social networks in the community. Newborn hearing screening has enabled earlier access to language (Kennedy, McCann, Campbell, Kimm, & Thornton, 2005) and has led to generally better speech and English language outcomes (Geers, 2004; Pimperton & Kennedy, 2012) as well as literacy outcomes (Pimperton et al., 2016). Access to effective EI in this population can have a profound positive impact on the building blocks for development of necessary language learning and communication for both spoken and sign language (Ching et al., 2017; Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998). However, many children who are DHH remain at substantial risk for speech and language delays, which can have significant long-term impacts on social and communication functioning (Cupples et al., 2016; Meinzen-Derr et al., 2018; Moeller, 2007; Moeller, Tomblin, Yoshinaga-Itano, Connor, & Jerger, 2007). In particular, gaps in reading achievement between DHH children who use cochlear implants (CIs) and their hearing peers typically become larger with age, just as they do among children who are DHH and use sign language (Geers, Tobey, Moog, & Brenner, 2008; Harris & Terletski, 2011).

Although family-centered EI has been shown to improve communication outcomes (Moeller, Carr, Seaver, Stredler-Brown, & Holzinger, 2013), little evidence exists for treatment in school-age children who have not reached developmental expectations. The most common interventions to increase spoken language communication in children who are DHH include speech-language therapy, in conjunction with hearing aids or CIs

to provide auditory access. Listening and spoken language therapy (LSL), also known as auditory-verbal therapy (AVT) has been advocated to improve communication functioning for children whose families choose this communication mode. A recent meta-analysis of AVT (Kaipa & Danser, 2016) reported that AVT may have a positive impact on developing speech and language skills, but limited research evidence and a lack of well-controlled group studies limits the evidence base for AVT. Spoken language preschools that use a data-driven instruction (DDI) approach have shown significantly higher scores on standardized speech and language measures, with 78% of students in a DDI group achieving scores in the average range, compared to 59% in a control group (Douglas, 2016). Although substantial progress has been made in EI for children who are DHH, important gaps remain in speech production, pragmatic use of language, and social-emotional abilities (Punch & Hyde, 2011; Wong et al., 2017).

To address these crucial areas of communication, interventions for children who are DHH has evolved in recent years and has incorporated improvements in technological advances. From an audiologic perspective, the risks of poor language outcomes are moderated by provision of early and consistent access to well-fit hearing aids that provide optimized audibility (Tomblin et al., 2015), and by family and educational supports. Additionally, because the communication environments differ markedly for English language and American Sign Language (ASL) approaches, these factors need to be considered when implementing specific therapeutic approaches in classrooms.

Marschark, Shaver, Nagle, & Newman (2015) addressed the complex interplay of many factors that impact the potential for academic achievement for students who are DHH. Personal characteristics that impacted academic achievement included the student's hearing levels, language fluencies, mode of communication (e.g., sign, speech), speech intelligibility, language functioning, and whether they had an additional disability. In addition, family environment (e.g., parent education level, socioeconomic status) as well as experiences inside and outside school (e.g., school placement, type of school, retention for one or more grades) were examined. Overall, students who attended regular secondary schools and had better spoken language skills received higher test scores across all academic subjects listed above. Consistent with the predictive factor of better spoken language for students in secondary schools, research also suggests that better spoken or signed English-language proficiency is critical to improved reading outcomes for elementary school students who are DHH. Nielsen, Luetke, McLean, and Stryker (2016) studied elementary and middle school students at a school that used spoken and simultaneous signed standard English, and found that better English language proficiency predicted reading achievement. In non-controlled observational studies, these factors could be the cause, rather than the effect, of better language

outcomes. That is, children with better language skills at transition from EI to school programs are more likely to be placed in mainstream school settings. Therefore, randomized controlled studies are needed to assess the impact of any new intervention, and are currently underway using the TALI approach.

Augmentative and Alternative Communication (AAC) Technology

Although innovations in technology have improved intervention for hearing loss, such as in digital hearing aids and CIs, it is important to also incorporate language learning options that optimize the improved auditory access made possible by these technologies. Although few studies could be found on the value of technology, Nakeva von Mentzer et al. (2013) studied a computer-assisted phoneme-grapheme correspondence training program in 5–7-year-old children who were DHH using hearing aids or CIs. This program required 10 minutes of practice per day at home and included parental involvement. Both hearing children and children who were DHH improved their accuracy of phonology production with this technology. Effect sizes were large, especially for the children who had poorer phonology production at baseline.

AAC is a communication system that could potentially be used to support and expand spoken and sign language to improve vocabulary and grammar skills for the purposes of expressing wants and needs, demonstrating social etiquette, transferring information, and maintaining social closeness or friendships (Light, 1989). Those who are unable to speak, or who have unintelligible speech, such as individuals with developmental disabilities, cerebral palsy, autism spectrum disorder, or multiple disabilities use AAC to effectively communicate with different partners and settings (Millar, Light, & Schlosser, 2006; Ronski & Sevcik, 2005; Ronski, Sevcik, Barton-Hulsey, & Whitmore, 2015). Although individuals who are DHH may benefit from using AAC, it is often not used with them due to an emphasis on spoken and sign language, even though they meet the criteria for need.

AAC has been studied in a small group of Korean children who are DHH (5 treatment, 5 non-treatment controls) with developmental disabilities and/or cerebral palsy who used CIs for more than two years. Nine out of 10 of the children were educated in a school for the deaf and used a combination of gestures and signs or had unintelligible speech. The children were implanted with CIs, on average, at age 4.7 years and were 8.7 years old. They had limited spoken Korean language skills (Lee, Jeong, & Kim, 2013) and used the AAC devices during 1-hour sessions once a week for 6 months. In this group, articulation for words, receptive vocabulary scores, and frequency of spontaneous communication improved significantly. They concluded that interventions using AAC technology hold promise for school-age children who are DHH.

One such technology is TALI, a novel approach that focuses on AAC as a spoken English language intervention for children who are DHH (Meinzen-Derr et al.,

2016). TALI uses an effective AAC intervention developed by Kent-Walsh & Binger (2013) called the Improving Partner Applications of Augmentative Communication Techniques (ImPAACT) program. Everyone learns to speak and communicate by listening and talking with others. However, children with complex communication needs (CCN), such as those who are DHH, have more difficulty learning to communicate using spoken language. Communication partners (e.g., family members, teachers, therapists, peers) are often ineffective in the strategies they are using when interacting and conversing with individuals with CCN and benefit from structured training. ImPAACT follows a three-pronged approach that includes selecting appropriate targets for communication, using effective instructional techniques, and purposefully structuring communication partner intervention programs (Kent-Walsh & Binger, 2013). When introduced as part of the intervention, the ImPAACT program is shown to improve children's communication skills, such as the number of turns taken, number of multi-symbol messages produced, and diversity of vocabulary used (Kent-Walsh, Binger, & Malani, 2010).

TALI combines these AAC strategies with up-to-date and socially acceptable technology (i.e., iPad®) to enhance and support spoken language development in children who are DHH with clinically significant gaps in language. The use of AAC is an evidence-based approach particularly useful with children who have a range of complex communication difficulties. AAC systems offer programs that are dynamic, auditorily appropriate, and visually stimulating in order to address communication deficits (Meinzen-Derr et al., 2016).

TALI uses TouchChat HD® with WordPower, by Silver Kite, as the AAC English language system accessed on the iPad®. WordPower is the generative word-based language system with extensive core and fringe vocabulary for effectively and efficiently creating grammatically correct sentences. When needed, the child can also easily add the appropriate morphological word endings to nouns, verbs, adjectives, and adverbs. A QWERTY keyboard with word prediction is also available so individuals can spell novel words if needed. TouchChat WordPower has multiple page sets that vary in the number of buttons per page, so the system can grow in complexity and continue to support the child as language skills develop. The use of such a system in users who are DHH allows for a novel option that integrates the child's communication system (combining the auditory components of hearing the words repeated from the iPad® system) with words they wish to speak visually chosen from the vocabulary system (with or without symbols). An example of a 60-cell TouchChat WordPower communication page used in TALI is pictured in Figure 1.

Results from our recent study of TALI (Meinzen-Derr et al., 2016) in a 24-week structured intervention in five children with bilateral hearing loss found significant pre-to-post intervention increases in participants' mean length of utterance, vocabulary, and mean turn length. These

















ABC 123	PEOPLE 	QUESTION 	ACTIONS 	PLACES 	SOCIAL 	TIME 	GROUPS 	DESCRIBE 	GOOD 
clear	I	me	don't	to	be-	come 	any- every- but or	a	more
.	my	can	eat 	drink 	finish 	go 	this	the	that
	it	do	get 	help 	know 	listen 	about	and	at
-s	you	is	like 	need 	play 	stop 	for	in	with
we	your	have	think 	want 	watch 	work 	of	on	out

Figure 1. Example of 60-cell WordPower communication page similar to that used in TALI (Technology Assisted Language Intervention).

short-term positive effects suggest that TALI may be a viable intervention approach for improving language development. This study highlighted the importance of studying the accessibility, feasibility, and approachability of this novel intervention into extant intervention models for children who are DHH.

Social Validity

A critical factor influencing the extent to which AAC interventions are perceived as being acceptable and feasible for youth with a variety of disabilities is their social validity (Logan, Iacono, & Trembath, 2017). Social validity broadly refers to the concordance between the measurable outcomes of an intervention and the goals, needs, and preferences of the recipients and interventionists who deliver it (Wolf, 1978). There are multiple methods that have been proposed to assess social validity of behavioral and clinical treatments, including traditional normative quantitative comparisons with peers' skills (Foster & Mash, 1999). However, the traditional quantitative approach is not generalizable to assess the acceptability, relevance, and adaptability of the intervention to other, non-clinical settings such as home, work, or school. Thus, qualitative approaches to facilitate discussion of meaning and relevance to families' real lives can fill this gap. Foster and Mash (1999) recommend that clinical researchers routinely assess variables relevant to treatment feasibility including treatment acceptability. This approach can identify and remove barriers for broader implementation. Ideally, social validity should be assessed during the development, effectiveness trial, and dissemination phases of treatment.

It is important to consider the framework of family-centered care when pursuing treatment, including AAC (Mandak, O'Neill, Light, & Fosco, 2017). However, parents of children receiving AAC interventions often perceive a sense of incongruity between their goals and their providers' understanding of their needs and the impacts of their child's difficulties on broader functioning (Calculator & Black, 2010). Families also have reported a range of concerns regarding the implementation of AAC interventions in home settings, including limited formalized training for family members (Lund & Light, 2007). Cultural and linguistic backgrounds also need to be considered and the challenges in formalized training for family members may be further impacted if considered in the delivery of AAC interventions (Kulkarni & Parmar, 2017). Providers may also be unaware of barriers that interfere with the generalization of an AAC intervention's success to environments outside of the clinic setting, including time constraints, unclear expectations about the goals of the intervention, limited resources, and difficulties with implementing AAC in a culturally-appropriate and family-centered manner (Jonsson, Kristofferson, Ferm, & Thunberg, 2011; Mandak & Light, 2018). Schafer and colleagues (2016) assessed the social validity of using three AAC modes (i.e., manual signing, picture exchange, and an iPad®-based speech generating device [SGD]) with teachers and undergraduate pre-service teachers. Most participants nominated the iPad®-based SGD as more socially valid regarding intelligibility, easiest to learn, and most effective.

A systematic and comprehensive evaluation of family and provider perspectives of novel AAC interventions allows researchers and clinicians to maximize the potential for an intervention to make a meaningful and lasting impact on children and their families by supplementing and expanding best-practice treatment approaches. Therefore, the goal of the present study was to investigate the feasibility of a novel intervention for children who are DHH, the TALI, from the perspective of families involved in the intervention study and professional stakeholders working with children who are DHH.

Method

Parents/caregivers of children who are DHH who had participated in a study of TALI intervention ($N = 11$) were approached to inform the social validity of the language intervention and the feasibility of accessing it on an iPad®. Table 1a provides the individual and group characteristics of participants in the TALI pilot program and Table 1b provides the individual participant data. All the children were receiving school speech and language therapy in addition to TALI and most reported working on different goals at school than in clinic-based therapy.

Table 1
Individual and Group Characteristics of Participants in the TALI Pilot Program

1a. Characteristic				
Median age at enrollment (years:months)			6;3 (range 3;10 to 10;8)	
Gender, Number Female:Male			5:6	
Etiology of hearing loss				
Unknown			3	
Genetic			2	
Enlarged vestibular aqueduct			3	
Cytomegalovirus			3	
Co-existing developmental disabilities			5 (45%)	
Median nonverbal IQ			96 (38–107)	
Nonverbal IQ < 85			5 (45%)	
1b. Individual Participant Data				
Participant	Age	Device use	Co-existing diagnoses	Receiving SLP therapy
Child A	7;1	Bi-CI	Cognitive-motor	Private
Child B	8;2	Bi-CI	None	School
Child D	7;0	Bi-CI	None	School
Child E	5;4	CI	None	School
Child F-a	9;10	HA	Cognitive-motor	Private & school
Child G	5;8	HA	None	School
Child H	10;8	Bi-CI	Autism	Private & school
Child I-a	3;11	CI	Cognitive	Private & school
Child J-a	5;7	Bi-CI	Motor	Private & school
Child K	5;5	HA	None	School
Child L	5;0	CI	None	School

Note. TALI = Technology Assisted Language Intervention; HA = hearing aid; CI = cochlear implant; SLP = speech-language pathology. Three children (with “-a”) had apraxia. Bolded lines indicate higher skills at baseline.

Structured interviews with parents/caregivers were used to qualitatively understand the social validity. Professionals working with children who are DHH were also queried through focus groups to understand the acceptability of using the intervention within their clinical and educational settings. A total of 26 adults participated in this study by responding to question prompts about the TALI intervention; seven parents/caregivers of children receiving TALI, two parents from the Cincinnati Children's Hospital Medical Center (CCHMC) audiology family advisory committee, and 17 professionals working with children who are DHH. To maximize the range and depth of information related to the social validity of the TALI intervention to children's environments, qualitative methods (specific question prompts and focused discussion) were employed during development and pilot phases of the TALI intervention program. Individual parent/caregiver interviews were conducted by e-mail or telephone for the 7 parents who participated in the TALI intervention, while in-person focus groups were held with the 2 parent advisory committee members and the 17 professionals working with children who are DHH. An in-person focus group for parents was attempted, but not enough parents were able to attend in person to make a focus group viable so interviews were conducted as an alternative.

Parent and Caregiver Focus Groups

Parents and caregivers were recruited based on their participation in the initial pilot study of the TALI (Meinzen-Derr et al., 2016). Eleven children participated in the initial pilot study and used TALI for 24 weeks. Seven of the 11 families agreed to participate in a follow-up questionnaire either by e-mail or phone. Four parents did not respond to either a second follow-up e-mail or phone call asking for their participation. The structured interviews of the seven parents were completed with parents/caregivers through either e-mail ($n = 5$) or telephone ($n = 2$). Questions focused on the overall effect of the TALI intervention (e.g., child's response, changes in behavior or communication, surprises), feasibility using the iPad technology (e.g., ease of use, difficulty understanding, motor or attention problems), and increased use outside of therapy (e.g., friends, family). Finally, parents and caregivers were asked two open-ended questions: "What is the best way to support families during therapy?" and "If you could change something about the therapy, what would it be?" The transcripts of the parent/caregiver interviews were reviewed by all researchers to categorize all responses to questions into main themes.

In addition to the structured interviews with parents of participants, we also recruited representatives of the CCHMC audiology family advisory committee in the role of other families of children who are DHH who had not received TALI treatment. These families participated in the first focus group described below.

Professional Stakeholder Focus Groups

Professional stakeholders recruited for the focus group

included audiologists and speech-language pathologists (SLPs) working with children who are DHH, EI providers working with children who are DHH, and teachers of the deaf. The focus groups were held over a 2-year period to involve a diverse array of participants. All were recruited through e-mail and asked to participate in one of the three focus groups. The professionals working with children (birth to age 18) who are DHH participated in one of the three focus groups that lasted for 2 hours each. None of the participants in the focus groups had children receiving the TALI intervention.

In the first focus group, participants included audiologists, speech-language pathologists, educators of children who are DHH, and the parents from the CCHMC audiology family advisory committee. In the second and third focus groups respectively, representatives were from two private schools for children who are DHH: one school uses an auditory-oral approach and the second school uses American Sign Language and a total communication approach which also includes spoken language, gestures, facial expression, and environmental cues such as pictures and sounds. Two of the children who received the TALI intervention were attending the auditory-oral school.

All the focus groups discussed the same topics and responses were written on large poster paper during the discussion and documented through recorded audiotapes. Predetermined and uniform small and large group questions were discussed during two separate parent and professional focus groups through telephone or email. Table 3 includes the list of the questions discussed. Each session opened with a general discussion about the strengths of children who are DHH, their communication needs, obstacles children who are DHH face and goals or expectations for children who are DHH. The discussion then addressed "What behaviors would you expect to see in children who are DHH **with** and **without** accommodations". Next, discussion focused on whether the group felt that AAC interventions/devices in general would support the development of language with children who are DHH. The specific TALI AAC intervention was then explained and demonstrated for the group. They were asked whether they had any concerns if a child in their setting were to use an AAC intervention similar to TALI, whether these concerns could be addressed, and could they see themselves using an AAC intervention like TALI in their educational setting.

Procedures

For the focus group sessions, we used Group Level Assessment (GLA), a qualitative and participatory research method in which timely and relevant data is collaboratively generated and interactively analyzed with key stakeholders (Israel et al., 1998). GLA is readily adapted for use by researchers and practitioners alike. It can be used in program evaluation, research, needs assessment, intervention planning, project management, curriculum development, and community-building. GLA involves bringing a group of participants together to build a common data base through the identification of relevant

needs and priorities where participants have the knowledge, experience, and expertise to crystalize the research focus (Reason & Bradbury, 2008).

The purpose of participation was provided to the participants, specifically to identify the most important and relevant needs related to the TALi results and the advantages and disadvantages in social validity in new contexts and environments. All focus groups in this study were convened using the principles of GLA in small group settings. Standardized question prompts and a relaxed, interactive method was used to elicit responses and to prompt discussion. Responses were documented through written means and recorded audio. Transcripts of the recordings were analyzed to capture all ideas and discussions.

Analysis of Responses

Qualitative analysis of the focus groups and the interviews was conducted by all investigators (n = 8). The professional background of the investigators included speech-language pathology, audiology, and psychology. One professional had extensive experience with individuals who worked with AAC and this investigator and one other had experience with deafness. A consensus approach, as is standard in GLA methodology, was used for discussion within the focus groups and from the transcripts by the researchers for categorization of primary themes gathered from the written transcripts of the interviews and focus groups. There were no disagreements among the investigators as to the final categories and themes.

Results

Parents or Caregivers

Categories and common themes were discussed and compiled into primary areas. The primary themes for strengths and barriers are listed in Table 2. Overall, parents thought that TALi was feasible to implement in both home and therapy settings. Regarding strengths of

TALi, parents and caregivers reported that their children had improvements in the quality and quantity of speech and language skills. They specifically described an increase in the variety of new words their children were using following the TALi intervention. They also noted that their children were using more grammatically correct sentences and appeared more confident in speaking with others. All parents found the iPad® easy to use with their children and were able to incorporate it into interactions with family members and close friends. All the children (n = 7) were using TALi with family at home. Three of the families were happy that their children were using it to converse with their peers, however two of these children, as noted below, were having difficulty with using it with their peers in the school environment.

In terms of barriers, most parents noted that it was difficult to implement TALi to facilitate communication when their child was fatigued or frustrated. Many parents noted that it was difficult to prioritize time to use TALi at home. Barriers for implementation at school were attributed to the lack of knowledge by adults or resources for them. For the two children who brought the iPad® with TALi to school, it was difficult to incorporate its use with their peers. One parent specifically noted technology issues related to charging, resetting, freezing, and troubleshooting.

Professionals Working with Children Who Are DHH

Accumulated responses from the three focus groups were examined, discussed, and categorized into primary areas and themes. These primary areas are provided in Table 3. As detailed in Table 3, professionals reported that TALi intervention would be useful for mainstreamed children who primarily use verbal expression and for teaching academic concepts such as writing, drafting emails, learning new vocabulary, et cetera. They also shared that the device could be an aid for families who do not use sign language or simultaneous communication with their child.

In terms of barriers, professionals were concerned that using TALi may slow the pace of communication in the

Table 2
Primary Themes Gathered from Parent/Caregiver Interviews (n = 7)

Strengths of TALi Intervention	Barriers to TALi Intervention
Increased quality and quantity of verbalizations (x6)	Difficulty implementing when the child was fatigued or frustrated (x6)
Improved grammar and syntax use in both verbal and written communication (x5)	Difficulty prioritizing time for TALi use at home (x5)
Increased vocabulary (x5)	Difficulty implementing at school due to lack of knowledge or resources (x2)
Ease and enjoyment of using the iPad® (x7)	Unable to incorporate into peer interactions at school (x2)
Incorporated into interactions with family members and close friends (x7)	Unavailable written/video instructions aiding parents in TALi execution at home (x2)
	Technology issues (x1)

Note. TALi = Technology Assisted Language Intervention.

Table 3
Primary Themes from Professional Focus Groups (n = 19)

Questions	Primary Themes
What are the strengths of children who are DHH?	<ul style="list-style-type: none"> • Strong visual-perceptive skills • Concrete “black and white” thinkers
What are obstacles for children who are DHH?	<ul style="list-style-type: none"> • Communication limitations • Socio-emotional difficulties • Difficulty keeping up academically
How would you describe the communication needs of children who are DHH?	<ul style="list-style-type: none"> • Receptive and expressive language delays • Need of visual supports (i.e., sign language)
What are your expectations for children who are DHH?	<ul style="list-style-type: none"> • Full integration into society, ideally • Ability to advocate for themselves
What behaviors would you expect of children who are DHH with and without accommodations?	<ul style="list-style-type: none"> • Improved participation and academic and language skills with accommodations • Frustration, withdrawal, and delayed comprehension without accommodations
What are your reactions with using AAC devices to develop language with children who are DHH?	<ul style="list-style-type: none"> • Concerns for ability to use sign language and AAC simultaneously • Requires good receptive language • Challenges to using TALI with peers • Useful tool for facilitating reading and writing activities
A child who is DHH that you work with is utilizing a similar AAC system to that used in the TALI intervention. What are your concerns?	<ul style="list-style-type: none"> • Slow pace of communication • No corrective feedback provided by the device • Work and time intensive to train the child to use the device • Disrupting the established language foundation of children who communicate using sign language
Can these concerns be addressed? If so, how?	<ul style="list-style-type: none"> • Changes to the software (increase vocal clarity and intensity, create an undo button, provide corrective feedback for mistakes) • Increase the 24-week speech therapy sessions to a more intensive 1:1 therapy for 1 year
Based on our discussion so far, how do you see yourself incorporating this into your daily practice?	<ul style="list-style-type: none"> • Useful for mainstreamed children who primarily use verbal expression • Teaching academic concepts such as writing, drafting emails, vocabulary, etc. • Aid for families that do not use sign language with their child.

Note. DHH = deaf or hard of hearing; AAC = augmentative and alternative communication; TALI = Technology Assisted Language Intervention.

school setting and that it would be disruptive with those children who used sign language or simultaneous communication. They also did not like that the device lacked corrective feedback when the child made an error and they wanted to be able to delete or change what had been said. They were concerned about the work and time it takes to train a child to use the device/language system.

All Participants

Both groups of professional focus group participants provided possible solutions to the barriers that were discussed. These included providing technical support and ongoing training, either in a written format (e.g., paper tutorials or cheat sheets) or using short videos. They shared that TALI would be useful for mainstreamed children who primarily communicate using speech and for

teaching the discussed academic concepts such as writing, drafting emails, and vocabulary and should be trialed in those settings outside of therapy.

The primary themes from Table 2 and Table 3 were grouped into broader areas and categorized into benefits and barriers in Table 4.

Discussion

The purpose of the present study was to investigate the social validity of the TALI intervention, a technology-based and AAC informed therapeutic approach with initial promising impact for children who are DHH with English language gaps (Meinzen-Derr et al., 2016). Using structured interviews, questionnaires, and a GLA

Table 4

High Level Summary of Parents/Caregivers and Professionals of the Positive and Negative Aspects of TALI Regarding Social Validity (n = 26)

Parents/Caregivers (n=7)	Professionals (n=19)
PROS	PROS
Increased quality and quantity of verbalizations <ul style="list-style-type: none"> • Improved verbal and written grammar and syntax • Increased use of vocabulary • Found iPad® easy and fun to use • Incorporated into interactions with family members and close friends 	<ul style="list-style-type: none"> • Useful for mainstreamed children who primarily use verbal expression • Teaching academic concepts such as writing, drafting emails, vocabulary, etc. • Aid for families that do not use sign language with their child
CONS	CONS
<ul style="list-style-type: none"> • Difficulty implementing when the child was fatigued or frustrated • Difficulty prioritizing time using TALI at home • Difficulty implementing at school due to lack of knowledge and resources • Technology issues (charging, freezing, troubleshooting problems) 	<ul style="list-style-type: none"> • Slow pace of communication • No corrective feedback provided by the device • Work and time intensive to train the child to use the device • Disrupting sign language

Note. TALI = Technology Assisted Language Intervention.

participatory approach, we assessed the feasibility of TALI in home, schools, and community settings. The main strength of this study is its inclusion of feedback from several critical stakeholders (e.g., parents and caregivers, professionals working with children who are DHH in both oral-aural and total communication approaches) who provided information regarding the generalizability of TALI in various settings. Overall, results suggest that TALI is a socially valid intervention that, with the provision of certain modifications to streamline its delivery, shows potential as a supplement to existing interventions for children who are DHH.

TALI incorporates a socially acceptable technology, an iPad®-based SGD (Schafer et al., 2016). This research is consistent with parent and caregiver positive feedback in an initial study that it is easy and enjoyable to use, meets the needs of families and is effective in increasing the quality (e.g., improved grammar and syntax) and quantity of their child's verbalizations. It should be noted that our study prioritized the child using their own speech rather than the device to speak their messages. Moreover, parents reported that they were able to successfully implement the system into daily interactions with others. This feedback is especially encouraging given that parents may express concerns about the clinical utility of AAC interventions in meeting their child's clinical goals (e.g., Calculator & Black, 2010).

In general, parents' concerns regarding TALI related to issues surrounding troubleshooting, glitches, and unclear instructions. For example, a few parents expressed frustration related to technical issues with the device (e.g., resetting, freezing, charging). Parents also expressed

concern that successful implementation of TALI in school settings could largely depend upon teachers' familiarity with the device itself as well as their ability to successfully navigate technical difficulties that may arise unexpectedly. Mandak & Light (2018) stated that school-based SLPs working with children with complex communication needs, especially those that require AAC to be successful communicators, must work with families, whenever possible, to achieve the best outcomes for their students.

Our results are consistent with the meta-synthesis by Chung & Stoner (2016), that for students to be successful academically, it is important to get the perspective of the student (when possible), the family, and the professionals (e.g., teachers, therapists) working with the student. Perspective and feedback are especially important when an AAC system is used to provide the needed supports of time, training (e.g., external, internal), and resources for the team to collaborate, evaluate, meet, and plan.

Feedback from educators suggested that TALI may also be promising in school settings. For example, professionals shared that the TALI system could supplement academic curricula, particularly for vocabulary and grammatical development. Educators at the oral/aural school thought that TALI may be particularly useful for families who do not use sign language. Alternatively, educators at the total communication school using both sign language and total communication thought that TALI could get in the way of communicating with sign language due to the manual nature of interacting with the device. However, they thought it could be useful for supporting vocabulary, grammar, and reading in small group or one-one instruction rather than for conversing in general.

Future Directions

To enhance the feasibility of TALI across settings, a clear avenue for continued improvement is the development of strategies that maximize successful use of the system in home and school settings. Indeed, repeated unsuccessful attempts to resolve troubleshooting issues with AAC systems may discourage families from continuing to use them (Angelo, 2000). Future studies examining the effectiveness of TALI as a supplement to existing interventions could provide technical support or ongoing training to parents and teachers in a video or written format. Perhaps the most practical option may be to provide an online tutorial that provides basic information regarding the operation of the device and solutions to common troubleshooting issues. More broadly, future studies implementing TALI should also assess the long-term effectiveness of TALI beyond the intervention period by following up with families and measuring progress in speech and language development.

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