TELECONNECTING: A MULTIPLE BASELINE SINGLE CASE EXPERIMENTAL RESEARCH DESIGN EXAMINING THE EFFECTS OF TELEPRACTICE BEHAVIORAL SKILLS PARENT TRAINING TO INCREASE ANSWERING SOCIAL QUESTIONS BY CHILDREN WHO USE SPEECH GENERATING DEVICES

by

BECKY CROWE

A DISSERTATION

Presented to the Department of Special Education and Clinical Sciences
and the Division of Graduate Studies of the University of Oregon
in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy

June 2021

DISSERTATION APPROVAL PAGE

Student: Becky Crowe

Title: Teleconnecting: A Multiple Baseline Single Case Experimental Research Design Examining the Effects of Telepractice Behavioral Skills Parent Training to Increase Answering Social Questions by Children Who Use Speech Generating Devices

This dissertation has been accepted and approved in partial fulfillment of the requirements for the Doctor of Philosophy degree in the Department of Special Education and Clinical Sciences by:

Dr. Wendy Machalicek	Chairperson & Advisor
Dr. Stephanie Shire	Core Member
Dr. Lauren Cycyk	Core Member
Dr. Lisa Mazzei	Institutional Representative

and

Andrew Karduna	Interim Vice Provost for Graduate Studies

Original approval signatures are on file with the University of Oregon Division of Graduate Studies.

Degree awarded June 2021

DISSERTATION ABSTRACT

Becky Crowe

Doctor of Philosophy

Department of Special Education and Clinical Sciences

June 2021

Title: Teleconnecting: A Multiple Baseline Single Case Experimental Research Design Examining the Effects of Telepractice Behavioral Skills Parent Training to Increase Answering Social Questions by Children Who Use Speech Generating Devices

Children with developmental disabilities and complex communication needs who use augmentative and alternative communication (AAC) have limited opportunities to communicate and few trained conversation partners to interact with. Research literature on interventions utilizing AAC devices and systems to increase communication skills overwhelmingly focus on researcher-mediated interventions to increase communication behaviors related to requesting items or information and responding to academic questions. The current study used a concurrent multiple-baseline design across 3 parent-child dyads to investigate the effectiveness of telepractice parent training on parent fidelity of a parent-mediated intervention using most-to-least prompts and progressive time delay. This parent-mediated intervention to increase children's responses to intraverbal personal questions using a speech generating device on video calls provides preliminary evidence that researchers can effectively use telepractice to deliver behavioral skills training to increase parent skills in using behavioral strategies to increase reciprocal communication by children with complex communication needs who use speech generating devices. Limitations and future research are discussed.

CURRICULUM VITAE

NAME OF AUTHOR: Becky Crowe

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:

University of Oregon, Eugene
University of Maryland College Park

DEGREES AWARDED:

Doctor of Philosophy, Special Education, 2021, University of Oregon
Master of Education, Early Childhood Special Education & Severe Disabilities, 2011, University of Maryland College Park
Bachelor of Arts, German Language and Literature, 2007, University of Maryland College Park

AREAS OF SPECIAL INTEREST:

Increasing Communication of Children with Complex Communication Needs
Training Communication Partners of Children who use Augmentative and Alternative Communication

PROFESSIONAL EXPERIENCE:

Special Education Teacher of Students with Autism in Self-Contained Elementary Classrooms, Blythe Elementary School, Charlotte-Mecklenburg Schools, 2013-2017

Special Education Teacher of Second Grade Students with Disabilities, Bollman Bridge Elementary School, Howard County Public School System, 2011-2013

Personal Support Worker, Children's Intensive In-Home Services, Oregon Department of Human Services, 2017-2021

GRANTS, AWARDS, AND HONORS:

Doctoral Research Award, University of Oregon, 2021

Thomson Family Scholarship in Education, University of Oregon, 2020

General Scholarship Award, University of Oregon, 2020

Davis Bricker Award for Student Research, University of Oregon, 2018

Project HEART: Heightened Excellence in Autism Research and Training, Office of Special Education Programs, 2017-2021

PUBLICATIONS:

Crowe, B., Machalicek, W., Drew, C., Wei, Q., & Ganz, J. (2021). Augmentative and alternative communication for children with intellectual and developmental disabilities: A mega-review of the literature. *Journal of Physical and Developmental Disabilities*.

Crowe, B. & Drew, C. (2021). Orange is the new asylum: Incarceration of individuals with disabilities. *Behavior Analysis in Practice*.

Wei, Q., Machalicek, W., Crowe, R., Kunze, M., & Rispoli, M. (2021). Restricted and repetitive patterns of behavior and interests in children with autism spectrum disorder: A systematic review of behavioral interventions. *Education and Training in Autism and Developmental Disabilities*.

Kunze, M., Drew, C., Machalicek, W., Safer-Lichtenstein, J., & Crowe, B. (2019). Language preference of a multilingual individual with disabilities using a speech generating device. *Behavior Analysis in Practice*, *12*(4), 777-781.

ACKNOWLEDGMENTS

I first wish to thank my research study participants – without you, I could not have had such a fun, enriching, and enjoyable experience completing my dissertation study.

Infinite gratitude to my advisor, Dr. Wendy Machalicek, for her invaluable guidance and for patiently answering my multitude of questions throughout the last 4 years. Thank you also for supporting my non-single case research deep dives into qualitative research and all the subject matter that those courses led me into. Thank you to my friends: for the hours of phone calls while I hiked Mount Pisgah, for all the texts while I learned new things, traveled to conferences, and shared celebrations and setbacks. Christine, Kathy, Diane, Niki, Annie, Juan, Qi – I could not have reached this point without all ya'll. Thank you to my parents for all of their support over the years. Thank you to Cailey, Aaron, and Jessica for helping me with data collection – your help was invaluable and crucial.

This study was supported in part by a United States Department of Education, Office of Special Education Programs, Leadership Training Grant, Project HEART: Heightened Excellence in Autism Research and Training (PI, Wendy Machalicek, #H325D150082) and a University of Oregon College of Education Doctoral Research Award.

For my former students in Maryland and North Carolina whose experiences cemented my dream of going back to school and becoming a professor.

For the kids I babysat all along the way – for the learning, for the experiences, for the fun.

For AH – thanks for sharing your life with me these last 4 years – your family, your laugh, your experiences. I wrote this research plan entirely with you in mind.

TABLE OF CONTENTS

Chapter Page

Chapter Page

Chapter Page

LIST OF FIGURES

LIST OF TABLES

Table Page

CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

In 2011, the World Health Organization reported in the World Report on Disability that over 1 billion individuals in the world have some type of disability and that approximately 200 million of these people experience significant challenges, or severe disabilities (Chan & Zoellick, 2011). Disability rates have increased and continue to rise, in part due to ageing of the world's population and growing numbers of individuals diagnosed with chronic health conditions (Light & McNaughton, 2012). Individuals with disabling conditions experience overall poorer quality of life, including poorer health outcomes, lower educational achievement, higher rates of poverty and less economic participation, and more barriers to accessing services (Chan & Zoellick, 2011). In the United States, the last federal census in 2010 reported that 18.7% of Americans of all ages lived with a disability and 18.6% of this population were birth to 24 years old.

Individuals with complex communication needs (CCN) comprised approximately 1.3% of the total United States population in 2013, or approximately 4 million people (Beukelman & Mirenda, 2013); however, this figure has likely increased along with the increasing incidence rates of autism spectrum disorder (ASD) and other disabilities impacting communication and language skills (Light & McNaughton, 2012). In late March 2020, the Centers for Disease Control (CDC) updated the ASD prevalence data among children aged 8 years in the United States: across the 11 Autism and Developmental Disabilities Monitoring Network sites across the country, 1 in 54 children, or 18.5 per 1,000, was diagnosed with ASD (Maenner et al., 2020). Every CDC update on ASD prevalence rates has demonstrated an increase in the number of children

diagnosed and current estimates of the number of children ages 3-17 years old with developmental disabilities are 17% as reported by parents to the CDC via the National Health Interview Survey (Zablotsky et al., 2019). Individuals with CCN encompass individuals with developmental disabilities including autism spectrum disorder (ASD), Down syndrome, cerebral palsy, and intellectual disability as well as individuals who acquire CCN either permanently, such as through stroke or dementia, or temporarily, such as via trauma, surgery, or intubation (American Speech and Hearing Association [ASHA], n.d.).

Augmentative and alternative communication interventions

AAC interventions are an established practice for increasing opportunities for communication and social participation for individuals with complex communication needs (Ganz et al., 2017). AAC includes unaided systems such as manual sign and gestures as well as aided systems such as the Picture Exchange Communication System (PECS; Bondy & Frost, 1994) and speech generating devices (SGD). Aided AAC systems include high tech speech generating aided communication systems (e.g. apps on mobile Apple™ devices; Logan et al., 2017) and low tech communication systems (e.g. PECS, eye gaze board, photographs or symbols on a ring or in a notebook). SGDs are mobile technology such as iPod™, iPad™, and iPhone™ applications that can be installed on tablets and smartphones or dedicated devices made solely for communication such as Prentke Romich Company's Accent® tablets programmed with a symbolic language with digitized speech output or visual scene displays on touchscreens incorporating photographs of familiar settings with hot spots to activate expressive communication options (Gevarter et al., 2013). Aided communication systems are

increasingly available, affordable, and portable, but intervention research is struggling to keep pace with the fast pace of technological advances (Still et al., 2014).

AAC interventions for children with IDD and CCN increase functional communication skills (Drager et al., 2010), increase language and social competence (Kent-Walsh et al., 2015), and can increase vocal-verbal speech in some individuals (Millar et al., 2006; Schlosser & Wendt, 2008). The ability to effectively and efficiently communicate wants, needs, and actively participate in social exchanges can improve quality of life and independence (Chan & Zoellick, 2011) and can improve cognitive development (Drager et al., 2010). Communication increases social closeness and is a crucial part of engaging in reciprocal exchanges to develop and maintain relationships, interact with family members, and increase participation (Therrien et al., 2016). There are advantages to using high tech SGDs over other forms of AAC, including conveying messages visually and verbally, gaining attention through audible speech, and using synthesized or digitized speech which enhances intelligibility (Schlosser et al., 2009), especially to unfamiliar listeners. Manual sign and picture exchange systems require fine motor skills from the communicator and require a trained communication partner/listener who understands both the symbolic language and idiosyncratic communication procedures (Mirenda, 2003). For example, in the Picture Exchange Communication System, the communication partner must be trained to accept the proffered picture symbol and say it aloud, then return it to the individual's symbol book (Bondy & Frost, 1994). Another disadvantage to low tech AAC systems are the fine motor and coordination skills required for manual sign and picture exchange systems, which increase response effort, especially for individuals with apraxia and mobility impairments

(Mirenda, 2003). High tech SGDs, which can be activated using eye gaze technology, head pointers or switches, or touching a large colorful button with body parts other than an isolated finger, e.g. knee, head, or elbow, provide more opportunities for accessing communication (Koch Fager et al., 2019).

Individuals with significant support needs are increasingly included in schools and communities (National Center for Education Statistics, 2019), are actively participating in their rehabilitation and care, and are participating in a wide range of activities such as sports, jobs, and hobbies. As mobile technology increases in prevalence and frequency of use, including by young children, communication with touchscreen devices via text- and image-based interactions is more popular and more accepted (Light et al., 2019). These concurrent increases in inclusion of students with disabilities and widespread use of technology across ages and abilities converge to popularize and normalize use of handheld touchscreen mobile devices for a variety of assistive functions. Recent examples of increased access through mobile technology include apps linking volunteers with individuals who have vision impairment such as Be My Eyes (Be My Eyes, 2020), and built-in accessibility features into operating systems such as text-to-speech, large font sizes, and voice-activated smart assistants (World Wide Web Consortium, 2017). Mobile technology is an essential part of daily life for many adults and even children, are interesting and motivating to children due to their prevalence and multiple functions, and are less expensive to acquire and maintain than dedicated high tech SGDs (Therrien & Light, 2016).

Most-to-least prompting

Response prompts to facilitate skill acquisition are a fundamental aspect of instructional strategies using principles of applied behavior analysis and include least-to-most prompt hierarchies, most-to-least prompt hierarchies, constant and progressive time delay, and flexible prompt fading (Cihon et al., 2019). Most-to-least prompting sequences the learner from the most intrusive prompt that consistently results in the target behavior to less intrusive prompts and ultimately no prompts, at which point the learner is independently and accurately responding (Demchak, 1989). Most-to-least prompt hierarchies have been used to effectively teach individuals with ASD and intellectual disability, have been demonstrated to be more effective and efficient than least-to-most prompting for some individuals (Cengher et al., 2016), and have resulted in faster acquisition of target skills with higher accuracy than other prompting systems (Cihon et al., 2019).

Progressive time delay

Incrementally and systematically increasing the amount of time between a discriminative stimulus and a response prompt, or progressive time delay, is a procedure for fading response prompts and can be utilized with a most-to-least prompt hierarchy to gradually fade from more intrusive prompts to less intrusive prompts (Walker, 2008). Progressive time delay transfers stimulus control from the prompt to the discriminative stimulus: the learner is presented with the discriminative stimulus and simultaneously prompted, ensuring the learner practices the target behavior often and with success. The response prompt is then systematically presented at a specific delay after the discriminative stimulus and that delay is incrementally increased as the learner is successful (Gast et al., 1988). Progressive time delay has been demonstrated to be

effective across individuals with developmental disabilities and in comparisons with other prompting procedures, found to be more efficient (Godby et al., 1987; McCurdy et al., 1990).

Social closeness

Developing functional communication systems for individuals with CCN to effectively and efficiently express wants, needs, and demonstrate knowledge enhances their quality of life (Mirenda, 2003), their ability to perform in school to the utmost of their ability (Rowland et al., 2015), and their social closeness with others (Ganz et al., 2017). Students with IDD and CCN who require AAC to communicate often experience social isolation due to their difficulty interacting with their peers; implementing AAC across communication partners contributes to longer and more frequent interactions and social inclusion (Chung et al., 2012). Individuals with severe and multiple disabilities experience multiple barriers to effective communication, including barriers in expressing intelligible speech and messages (Weiner, 2005), responding to communication breakdowns, and skill deficits around clarifying and repairing messaging when communication breakdown occurs (Snell et al., 2008). Students with severe intellectual disabilities, including those with CCN, spend most of their school days in special education classrooms or are educated in segregated special schools away from typically developing peers (Kleinert et al., 2015). Making and maintaining friendship relationships are challenges for individuals who spend less time with peers, exhibit difficulties in understanding and expressing spoken language, and may have mobility impairments that limit or inhibit participation in extracurricular activities with peers, such as sports and after school clubs (Anderson et al., 2011). High school students with and without

diagnosed disabilities who do not have friends can experience loneliness, disengagement from school, and depression as a result of social isolation (Laursen & Hartl, 2013). In addition to fewer opportunities to spend time with peers, students with severe disabilities spend most of their time with special education personnel and are accompanied by teachers and educational assistants when they are included in general education classrooms and activities (Asmus et al., 2017).

Qualitative research methodologies that have explored whether individuals with disabilities have reciprocal friendships and whether those friendships are stable over time find fewer reciprocal relationships and less stable friendships than are identified between non-disabled peers (Østvik et al., 2018; Schwab, 2019). Students who use AAC report having friendships at school but are not perceived as playmates or identified as friends by peer students without disabilities, indicating that relationships between individuals with disabilities and peers are not reciprocal (Østvik et al., 2018). Communicative acts from individuals with disabilities, particularly individuals who do not use vocal verbal speech, can be idiosyncratic and difficult for peers to interpret and understand, further impeding engaging in conversations and discussing shared interests (Anderson et al., 2011).

Because individuals who use AAC have limited opportunities to interact with peers and build stable relationships, establishing and maintaining relationships with family members may be of even greater importance. Family members of individuals with multiple support needs often serve as caregivers as well as emotional and social supports, are often the primary communication partner, and are consistent across time. Parent training to teach parents effective research-based strategies and interventions to not only communicate with their children who have significant support needs but to also facilitate

child learning outcomes increases parent skills and knowledge, decreases parent stress, and increases child outcomes (Iadarola et al., 2018). Increasing parent and family engagement in intervention programs through parent mediated interventions creates effective natural change agents and provides more opportunities for children to acquire, practice, and maintain skills (Nunes & Hanline, 2007).

Successful communication is considered a prerequisite for reciprocal conversation and social affiliation, which can lead to friendship (Weiner, 2005; Whalon et al., 2015). Conversation skills required for success include turn taking, extending conversation beyond a single turn, changing topics, and repairing the conversation if needed (Weiner, 2005). Due to the time necessary to find vocabulary and put together phrases, individuals who use AAC to communicate require longer inter-response intervals and wait time from communication partners (Light et al., 1992). These challenges may not be understood or accommodated for by untrained communication partners (Kent-Walsh & McNaughton, 2005), decreasing the number and duration of interactions and providing fewer opportunities for individuals who use AAC to participate in conversations. As children age out of school, barriers to social interaction only increase: lack of friends and difficulty making friends were identified by adults who use AAC as barriers to participation (Dattilo et al., 2008).

Children with disabilities who use AAC interact more often with adult caregivers and educators even when peers are present in inclusive settings (Chung et al., 2012) and take only 3% of conversational turns with peers (Andzik, 2016). Most interventions involving increasing the communication skills of individuals who use AAC focus on manding (requesting) rather than additional communication functions such as requests for

information, intraverbals, or commenting (Logan et al., 2017; Still et al., 2014). Intervention studies focusing on increasing conversational skills by increasing complex verbal behavior of individuals who use high tech AAC remains a gap in the literature (Ganz et al., 2017).

Expertise with and skilled implementation of technology and vocabulary necessary to use high tech AAC systems require training and practice and place high operational demands on the person who uses AAC and their communication partner (Caron et al., 2015; Holyfield et al., 2017). These barriers decrease motivation and increase response effort by the individual who uses AAC to communicate and can lead to device abandonment (Light & McNaughton, 2012). Most AAC research is researcher-mediated, using highly skilled individuals, often with extensive experience working with individuals with CCN and who have received training and experience using high tech SGD systems (Ganz et al., 2017). Outcomes from these intervention studies have not been evaluated to see if they generalize across natural communication partners or for long term maintenance of newly acquired skills, both of which are needed for effective and lasting behavior change by individuals who require AAC to meet their daily wants and needs (Light & McNaughton, 2014).

Intraverbal communication

In his 1957 book, *Verbal Behavior*, B.F. Skinner described four verbal operants: mand, tact, echoic, and intraverbal. Intraverbal behavior refers to a verbal response evoked by different verbal stimuli without point-to-point correspondence, for example answering "*How old are you*?" with "*16 years old*." The number of years has no direct connection, formally, to the words expressed by the questioner. Intraverbal behavior is

maintained by generalized reinforcement; unlike manding, in which the listener receives the requested item or information (Ingvarsson & Hollobaugh, 2010). Learning and maintaining an intraverbal repertoire facilitates conversational skills, responding to novel verbal stimuli, and advanced conversational skills such as telling a story (Stauch et al., 2017).

To date, most research on increasing SGD use by people who have CCN has emphasized teaching individuals to mand and tact, or request and identify people, places, or things (Morin et al., 2018). Most research on teaching individuals to increase use of any of the four verbal operants focuses on manding, followed by tacting, and very little research teaches individuals with IDD to use intraverbals (Sundberg & Sundberg, 2011). Studies targeting the intraverbal mainly teach individuals with ASD who do not also have CCN; to date there is a single study focusing on participants who have IDD and CCN and teaching them to respond to questions (Carnett & Ingvarsson, 2016). In this replication study, researchers taught a child with ASD to mand for answers to unknown questions using Proloquo2Go® on an Apple iPad®. The participant was taught to use his SGD to mand *I do not know, please tell me* or answered questions asked of him in a multiple-baseline across three question sets single case research design. The participant learned to mand for information when he didn't know answers the intraverbal questions asked of him and successfully learned those answers to respond to unfamiliar questions correctly. This study demonstrates that children with ASD who use SGDs can be taught to respond to intraverbal questions, to use their SGD to mand for information, and provides preliminary evidence that children with developmental disabilities who use SGDs can learn complex mands and intraverbal communication exchanges.

Intraverbal responding can be controlled by complex and compound verbal stimuli and conditional stimulus control (Eikeseth & Smith, 2013). Research on interventions to increase intraverbal responding by individuals with IDD focus on answering questions, completing fill-in sentence starters, providing a list of items in response to a discriminative stimulus such as, "*Tell me some [category]*", or telling stories (DeSouza et al., 2017). Teaching and prompting individuals with IDD to correctly respond to intraverbal discriminative stimuli includes model prompting in sign language (Valentino et al., 2012), using an echoic prompt and time delay (Ingvarsson & Hollobaugh, 2010), picture prompts (Ingvarsson & Hollobaugh, 2011), and increasing response variability with instructive feedback (Carroll & Kodak, 2015). Teaching intraverbal responses most frequently utilizes stimulus transfer procedures, either tact-to-intraverbal or echoic-to-intraverbal, to teach the correct response to the conditional verbal stimulus (DeSouza et al., 2017; Raulston et al., 2013).

To date, an electronic database search of ERIC, PsycINFO, and Academic Search Premier for AAC and intraverbal interventions yields a single study investigating use of an iPad as an SGD to increase intraverbal responding by children with ASD who use AAC (Lorah et al., 2015). Researchers used a multiple-baseline across responses design to teach two children ages 8 and 12 years old to answer three personal information questions each using Proloquo2Go® installed on an iPad. Each child was taught using a 5 s time delay with full physical prompting and each learned to respond to three questions (e.g. "*Where do you live*?). This study provides preliminary evidence that high tech mobile technology SGDs can be used by children who use AAC to acquire skills in using verbal operants other than basic mands.

Parent mediated intervention

Parents are natural change agents who are educating, prompting, and rewarding their children's skills and verbal behavior across contexts, new people, and across time (Roberts & Kaiser, 2011). Parent training on AAC has also successfully trained primary caregivers to implement PECS phases with high treatment fidelity and led to increased communication acts by children (Nunes & Hanline, 2007; Park et al., 2011). Parents have also been successfully taught to implement functional communication training with their children with socially significant reductions in child challenging behavior rates and frequency and increases in use of functional communication responses (Gerow et al., 2018; Wacker et al., 2013).

Parent training has been demonstrated to increase parent efficacy, reduce parent stress, and increase parent coping skills (Machalicek et al., 2015) as well as increase child skill gain and use (Iadarola et al., 2018). Effective interventions to train parents to implement interventions with children with IDD incorporate training modules, modeling target behaviors, providing feedback either during or immediately after practicing target behaviors, receiving live coaching, and receiving feedback (Machalicek et al., 2015; Wright & Kaiser, 2017). Much of the behavioral parent training literature including children with IDD focuses on coaching parents to conduct experimental functional analyses and training parents to implement functional communication training or other behavioral interventions to reduce child challenging behavior; to date, there are very few published studies on parent training aimed at increasing communication skills of children who use AAC (Park et al., 2011; Nunes & Hanline, 2007).

Applied behavior analysis

The use of principles of applied behavior analysis (ABA) is an evidence based practice as defined and established by the What Works Clearinghouse (WWC; 2020a), but its application to teaching communication skills with SGDs has primarily focused on expressive communication skills such as student's requesting objects or activities (Ganz et al, 2012). A review of literature on use of high tech AAC covering publication years 1990 through 2015 found that most research focuses on the use of time delay instruction, requesting wants and needs, and uses the researcher as the implementer of intervention (Ganz et al., 2017). Reporting on individual behavioral strategies, specific AAC devices, specific user interfaces and vocabulary, and generalization data was variable and limited (Ganz et al., 2017).

Behavioral skills training

Applied behavior analysis, the science and technology of behavior and behavior change, has been studied and applied across individuals, groups, educational and professional settings, with individuals with severe and multiple disabilities, and has provided the field of special education with a foundation upon which to build interventions and effect behavior change in the lives of individuals with disabilities (Machalicek et al., in press). Behavioral skills training (BST) employs principles of applied behavior analysis to teach individuals novel skills using direct instruction and explanation, modeling or demonstrating the skill, rehearsing and role-playing the skill, and shaping the behavior through coaching and feedback (Miltenberger, 2011). Additional techniques following initial training should additional support to maintain treatment fidelity be required include progress monitoring interventionist treatment fidelity, feedback and coaching, in vivo training sessions with the coach to practice any

missed or incorrectly implemented steps, and positive reinforcement to increase adherence to the intervention in the future (Miltenberger, 2011).

BST has been used in a wide variety of contexts including but not limited to effectively teach implementation of PECS procedures to educational staff (Rosales et al., 2009), teach children how to safely respond if they come across a firearm (Lee et al., 2018), to teach dental care professionals strategies to best provide dental care to individuals with ASD (Graudins et al., 2012), and teach an individual with ASD the job skills necessary for working in a restaurant (Morgan & Wine, 2018). While BST has been used effectively to teach a variety of skills to individuals with disabilities and their teachers, it has not been explored as an effective way to teach individuals with disabilities and complex communication needs, nor has it been used to prepare natural change agents to teach communication skills with children who use AAC except in Rosales, Stone, and Rehfeldt's article describing the use of BST to teach school-based staff to implement PECS procedures (2009). BST has proven effective across settings, populations, and purposes but has yet to be applied to interventions involving high tech AAC systems or with communication partners of individuals who use AAC.

Telepractice intervention delivery

Documented shortages of trained and skilled professionals in fields related to educating individuals with IDD, particularly speech language pathologists (SLPs) and board certified behavior analysts (BCBAs), have led to the investigation of telepractice to meet the demands for services (Simacek et al., 2017). Telepractice refers to the use and application of telecommunications and information technology to provide access to behavioral health and educational services across distance (Tomlinson et al., 2018).

Telepractice-delivered intervention by skilled service providers to parents is a growing area within the research literature and is in increased demand due to the global pandemic of COVID-19 and subsequent physical distancing, particularly school closures (St. George et al., 2020). Students with IDD, especially those with multiple significant support needs, require and are eligible for related services delivered by trained, skilled, and specialized therapists; however, due to school closings and transitions to online learning, these students are likely not accessing a free appropriate education, nor are they receiving the specialized services needed to maintain their quality of life. Telepractice interventions training parents on how to engage in physical therapy exercises, specialized delivery of instructional targets, management of challenging behavior (Machalicek et al., 2016), and strategies to evoke and model communication skills are now necessary for children with IDD and multiple disabilities to participate in daily routines with their families and maintain skills.

Prior to most of the United States population moving to online-only interactions, families living in rural and remote locations, families with medically complex children , or families with limited time to devote to traveling to and from clinics have been taught, coached, and provided therapy through telepractice (Akemoglu et al., 2019; McLay et al., 2020; Tomlinson et al., 2018). There is a substantial literature base on telepractice parent training interventions encompassing parent training to implement communication interventions (Akemoglu et al., 2019), parents have been taught to implement enhanced milieu training with their children to increase parent use of naturalistic communication strategies (Wright & Kaiser, 2017), implement a manualized early intervention program (Vismara et al., 2013; Vismara et al., 2018), and implement assessment and intervention

techniques grounded in the principles of applied behavior analysis (Peterson et al., 2017; Suess et al., 2013; Wacker et al., 2012;). Parents also learned to conduct communication interventions via remote coaching following completion of online training modules and found telepractice interventions to be feasible, acceptable, and overall positive experiences (Simacek et al., 2017; Stockwell et al., 2019; Tsami et al., 2019).

Compounding the chronic shortage of skilled SLPs in the United States, among practicing SLPs there is an additional shortage of trained SLPs with experience in AAC interventions for children with severe disabilities (Costigan & Light, 2010; Squires, 2013). There are no AAC-specific certifications within ASHA, making it difficult for school systems, parents, and other related service providers to recommend or find skilled SLPs with experience with AAC nor are there AAC-specific programs of study or certification within special education or behavior analysis training. Without a clear registry or process to find and acquire educators and therapists with AAC knowledge, those that do have experience and are up to date on intervention research are in high demand. Respondents to the 2018 ASHA SLP Schools Survey reported carrying average monthly caseloads of 47.5 students and 20.5% of respondents reported that lack of training to work with specific disorders of special populations was their greatest challenge as a professional (ASHA, 2018). Of the 1,539 respondents, 60.3% reported regularly serving an average of 5.3 clients who were nonverbal and required AAC each month, and 39.9% of respondents indicated they would like to see information about AAC in ASHA journals. Training additional interventionists and natural change agents for children with IDD and CCN is of paramount importance with the dearth of skilled

professionals and the short amounts of time each can devote to all of the children on their caseloads.

Most telepractice research intervention studies focused on training parents via videoconferencing software to conduct functional analyses and implement functional communication training with children with IDD (Bearss et al., 2020; Tomlinson et al., 2018). Reported barriers to interventions focusing on coaching parents via telepractice include technical difficulties, problems with transferring large video files from parents to researchers, and concerns about protecting confidentiality while transferring data and video recordings. As more of the world moves to videoconferencing, including increases in the use of telemedicine and telepractice by medical and therapeutic professionals, the United States Department of Health and Human Services has relaxed adherence to and enforcement of regulations issued under the Health Insurance Portability and Accountability Act of 1996 (HIPAA).

Social validity

Social validity is rarely evaluated outside of the original intervention contexts (Carter, 2007; Reimers et al., 1992), measured at multiple points in time (Schwartz & Baer, 1991), and rarely leads to changes in intervention procedures to increase treatment acceptability by the consumers (Schwartz & Baer, 1991). In AAC research, programming for social validity could include assessing social validity before, at multiple time points during intervention, and at regular intervals as part of follow up procedures by asking the AAC user and primary communication partners (teachers, parents, peers) whether the intervention had a significant and lasting effect on behavior change (Leko, 2014). Social validity measurement could also incorporate different communication settings: teachers

and peers could provide contextual information specific to school, parents and siblings provide information specific to home and community settings, and the AAC user and communication partners could comment on the settings in which the most noticeable changes in interactions occurred (Ledford et al., 2016).

For individuals with CCN who use AAC to communicate, assessing consumer satisfaction should involve the AAC user to the greatest extent possible. A familiar adult and same age peer could ask the AAC user for their input, providing the researcher with a richer analysis of the user's experience told to different and ecologically valid communication partners. For AAC users who don't yet have the communication skills to directly respond to or address their lived experiences, researchers and practitioners could use other ways to determine the social validity of interventions and practices. Asking stakeholders and peers about the social acceptability and emotional affect of participants via video (Lancioni et al., 2006) and comparing behavior change to that of peers (Ennis et al., 2013) are two examples of strategies to increase social and ecological validity of intervention procedures.

Selecting AAC vocabulary that is socially relevant to the user could also increase treatment adherence and maintenance of communication skills. AAC vocabulary is often selected by adults, particularly parents and professionals (Trembath et al., 2007), who carefully curate frequently used or socially appropriate vocabulary for the AAC user, potentially without considering what the user's peers are actually saying to each other. Conducting observations of the AAC user's same age peers and collecting language samples in a variety of contexts and with a variety of conversation partners (teachers, parents, friends) would yield more ecologically valid communication targets and

vocabulary (Schwartz & Baer, 1991). Incorporating the child who uses AAC in selection of vocabulary and selection of intervention targets as well as their family members would increase access to contextually relevant content and potentially increase communication system use.

Additionally, switching out social validity rating scales with open ended questions asked of intervention stakeholders such as parents and teachers creates opportunities for greater detail and richer information about treatment acceptability (Finn & Sladeczek, 2001). Analyzing themes that arise from rich responses elicited by open ended questions leads to new information for the field of applied behavior analysis regarding treatment acceptability and identification of barriers and facilitators to implementation of interventions in natural settings (Leko, 2014). This information is used by researchers and clinicians to modify current practice, increase the acceptability of future interventions, and move the field forward to create more positive relationships between consumers and researchers. Data from open ended questions also identifies unforeseen factors that influence treatment adherence, unpredicted side effects of treatment, and incorporate consumers' experiences with implementing interventions in their lives (Leko, 2014).

Generalization

Generalization was first directly addressed and recommended as a practice requiring active programming in intervention by Stokes and Baer's 1977 article, "An Implicit Technology of Generalization". Many of the recommendations they made continue to be areas of methodological weakness in single case research designs. Stokes and Baer identified "train and hope" as the most frequently used method for generalization, and with rare exceptions, train and hope continues to be the most

frequently employed generalization technique, rather than explicitly programming for generalization from the start of intervention development (1977). The second most frequent generalization technique is sequential modification: after the intervention ends and generalization is found absent, procedures are started to facilitate stimulus control across subjects, settings, interventionists, and generalization of responses (Stokes & Baer, 1977). Both of these techniques take place after the fact and do not incorporate generalization programming from the beginning of intervention.

Bringing responses under the control of naturally occurring stimuli leads to greater generalization and maintenance of newly acquired skills (Stokes & Osnes, 1989). Generalization programmed a priori into intervention procedures with the intent of not only increasing the target behavior with different people and across different environments increases the methodological quality of the design and ecological validity of intervention procedures (Stokes & Baer, 1977), and also increases the frequency of the target behavior in appropriate contexts in natural settings (Stokes & Osnes, 1989). In AAC research, bringing functional communication skills under discriminative control may require additional programming during intervention or follow up interventions after the user has learned the communication skill to then teach discrimination of under which conditions to exhibit that target behavior. Specifically, taking intervention out of an artificial intervention setting, whether that is a clinic therapy room or a speech language pathologist's office and out into the natural environment of the AAC user: conducting an intervention session once a month in the school cafeteria, in the classroom with the general education teacher as the interventionist, conducting an intervention session on a field trip or during recess would increase generalization and use of skills in natural

contexts (Mace & Nevin, 2017). If changing intervention settings is not feasible, incorporating more communication partners such as the AAC user's classmates and siblings, parents and outside therapists, music and physical education teachers would all increase generalization and increase the social validity of using an AAC system across multiple communication partners for all involved.

In single case research designs, generalization probes during baseline, intervention, and during maintenance add to the methodological rigor of the intervention design and aid the researcher in making decisions about the effectiveness of the intervention. Stokes and Baer called this method training to generalize (1977): training the AAC user to use the target behavior skill across different conditions. This method requires upfront work by the researcher to ensure generalization will take place instead of expecting it as an inductive outcome of the intervention's resultant behavior change (Stokes & Baer, 1977). Planning for generalization before intervention begins, incorporating the AAC user's personal communication needs in different environments and with different communication partners, and selecting appropriate and socially valid intervention targets increase the likelihood and frequency that the user will contact natural reinforcement once intervention ends (Stokes & Osnes, 1989).

In AAC research, training the AAC user's most frequent communication partners enhances both generalization and maintenance of the newly acquired skills. Generalization in the absence of reinforcement places the target behavior on extinction (Mace & Nevin, 2017). Regarding AAC interventions, reciprocal social interactions, potential resultant social closeness, and positive reinforcement of the user being understood and having their needs and wants met may serve as natural reinforcers for the

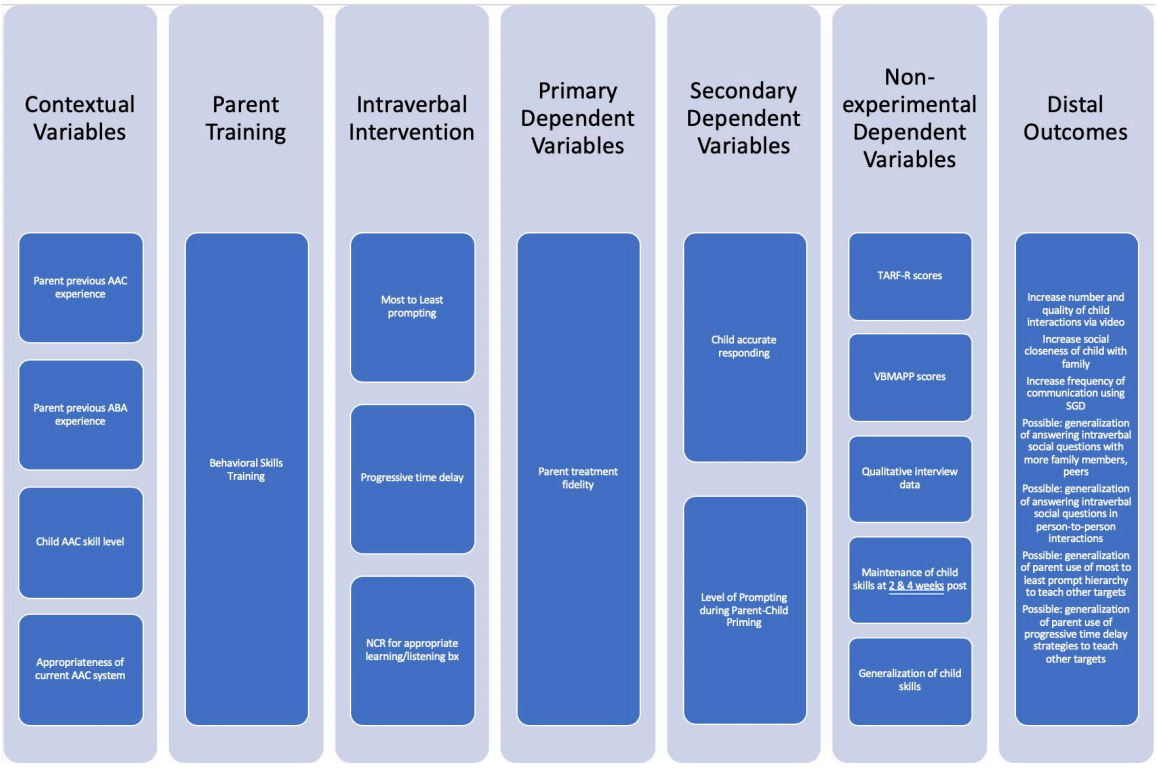
target communication behaviors (Calculator, 1988). Houghton and colleagues observed that teaching staff responded to 6.98% of communicative acts initiated by individuals using AAC (1987), effectively putting communicative behaviors on extinction (Calculator, 1988). Training communication partners in strategies such as sitting close enough to the AAC user to see the communication system and establish themselves as an audience, assessing and using the communication partner's skills as a jumping off point for coaching and intervention on responsiveness, and training the communication partner to recognize and respond to the user's communicative initiations increase the frequency of the AAC user's communication behaviors and opportunities to contact natural reinforcers (Calculator, 1988).

Maintenance

Assessing maintenance, or whether generalization has occurred across natural contexts for the user and determining if social validity of the intervention changes after practicing the new skills across natural routines assists researchers with developing socially significant interventions. With increased use, ease of access, and prevalence of technological communication modes, researchers can check in with AAC users and stakeholders without a large time or cost investment. Researchers can check in via email, video teleconferencing software, text message, or direct message through social media with links to online surveys or conduct a telepractice-type consultation for data collection. The use of surveys, a source of rich qualitative data for researchers, is also used to inform future intervention development and assist researchers in decision points to re-teach the target skill or modify the original intervention for re-teaching.

Logic Model

Figure 1. Logic Model of Teleconnecting Experimental Design



The use of video teleconferencing software to connect family members across distance has been made crucially important by the COVID-19 global pandemic during which health authorities recommend social distancing and minimizing travel (National Center for Immunization and Respiratory Diseases, Division of Viral Diseases, 2020). To date, there is a single study investigating the use of video-chat technology by children with ASD (Brodhead et al., 2019). Researchers developed and used social conversation scripts to teach three 7-year-old males with ASD using a nonconcurrent multiple-baseline across participants with an embedded alternating treatments design. Outcomes of interest were accuracy of social conversations and percentage of varied responses during video chat. All three participants increased conversation script accuracy and increased varied responses during conversations, providing preliminary evidence that children with developmental disabilities, in this case children with ASD, can learn to participate in

video chat conversations and can give varied responses after learning scripted intraverbals. This study was conducted in a university clinic setting with university-based clinical staff as conversation partners via an in-person intervention with children with ASD who communicate with natural speech. A gap in the literature remains on teaching children with other developmental disabilities including children who use AAC to participate in video chat conversations and future research into the use of parent training as well as telepractice parent training is warranted as well.

Purpose

This study aims to address gaps in the research literature pertaining to parent training interventions for parents of children with IDD and CCN who use SGDs to increase parent use of strategies based on systematic teaching procedures and child social communication outcomes. This study will investigate whether children who use SGDs can effectively be taught by their parent using most-to-least prompting and progressive time delay to answer social intraverbal questions and assess the acceptability of telepractice technology for increasing parent knowledge and skills of SGD use and increasing child social interactions with SGDs. To date, there are no published peer reviewed studies on the use of telepractice for parent training on behavioral interventions to increase child communication skills to answer intraverbal social questions with an SGD.

Research Questions

Experimental research questions

Is there a functional relation between telepractice parent training using behavioral skills training and an increase in average parent intervention fidelity of parent mediated most-to-least prompts and progressive time delay?

Is there a functional relation between an increased level of parent mediated most-to-least prompts and progressive time delay and an increase in level of child's prompted and spontaneous use of an SGD to respond to intraverbals on a videoconference call?

Non-experimental research questions

How does a parent mediated intervention change social closeness and increase positive interactions between children who use AAC and their parents and extended family members?

How do children with CCN perceive the feasibility, acceptability, and effectiveness of a parent mediated intraverbal intervention using their SGDs?

How do participating parents perceive the feasibility, acceptability, and effectiveness of a parent mediated intraverbal intervention delivered via telepractice to increase responding by their child who uses an SGD during a videoconference call with their relative?

How do parents not participating in the intervention and other non-participating family members perceive the feasibility, acceptability, and effectiveness of a parent mediated intraverbal intervention to increase responding by their child who uses an SGD during a videoconference call with their relative?

Are there positive effects of participation in a parent mediated intraverbal intervention regarding continued social interactions and communication exchanges

between communication partners and children who use SGDs at 2 and 4 weeks post-intervention?

CHAPTER II

METHOD

Participants

Inclusion and Exclusion Criteria

Inclusion criteria for children included: (a) ages of 8 - 18 years old and have IDD and use a speech generating device. IDD was established via parent report either of special education eligibility through the Individuals with Disabilities Education Act or medical diagnosis. CCN was determined by speech language service eligibility and/or having an SGD through school or private speech therapist. Each child participant must (a) have an SGD for use at home, (b) demonstrate the ability to independently mand (i.e. request) using at least five different graphic symbols, (c) tolerate physical prompting using hand under or over hand by their parent, (d) not engage in challenging behavior that interferes with their participation in up to 15 min sessions in a single room of their home within 3 ft of their SGD, and (e) physically activate their SGD (e.g. with finger, hand, switch, head pointer, or other body part; individuals who utilize eye gaze were excluded from this study). Children must also have the ability to follow parent directives to come to an area of their home and engage with their SGD for up to 15 continuous minutes.

Exclusion criteria for child participation included (a) primary language other than English, (b) challenging behavior that interferes with researcher data collection via videoconferencing technology (e.g. frequently occurring above conversational vocal stereotypy or gross motor stereotypy where the child is not visible on-screen), and (c) parent or child with a sensory impairment or disability that impacts the child or parent's understanding of questions asked vocal verbally by another person via video call.

Parent interventionists were a self-selected parent/caregiver of each child who uses SGD. For recruitment, parent was defined as a biological parent, primary caregiver, and/or adoptive/foster parent. All participating parents were biological parents with experience completing school activities and speech language therapy sessions via Zoom and integrating their child's SGD into daily life. For parent training and intervention, a single parent was trained and served as the interventionist. The trained parent had access to all training materials and intervention materials after completion of baseline sessions, throughout, and following completion of the research study.

Three parent-child dyads were recruited and participated in all phases of the study. Parent characteristics are reported in Table 1 and child-specific characteristics are reported in Table 2. Each child had a school-provided SGD that had been in use for at least 1 year prior to beginning this study and used their SGD multiple times each day at home with family and during online school activities. Each parent was familiar with their child's SGD, including navigating pages, finding icons, and basic maintenance of the tablet itself.

Dyad 1 consisted of Anne (mother) and Max (14 year old son). Max was a White male with medical diagnoses of autism spectrum disorder, seizures, anxiety disorder, and obsessive compulsive disorder. Max received speech language therapy, occupational therapy, physical therapy, augmentative communication services, assistive technology services, and special education services at school. Max also received applied behavior analysis services, speech language therapy, occupational therapy, physical therapy, assistive technology services, and had a personal support worker (PSW) outside of school. Max used TouchChat installed on an Apple iPad and had been using his SGD for

over a year. Max also expressed some words with vocal verbal speech (no, good, yeah), took others' hands and bringing them to desired objects or activities, and was learning to spell and type words on his SGD that were not preprogrammed. Anne was a White female who had completed college. They lived with six family members at home (2 adults, 1 adult child, and 3 children) and reported family income as "just enough to meet needs". Anne and Max lived 25 miles away from the university.

Kevin (father) and Hannah (8 year old daughter) comprised Dyad 2. Hannah was a White female diagnosed with a rare neurogenetic condition that impacted her mobility, speech, vision, and she relied on others for all of her daily needs. She had orthopedic impairment, cognitive vision impairment, and other health impairment eligibility for special education, speech language, physical and occupational therapy, augmentative communication, vision, and nursing services at school. For communication, Hannah used head switches connected to her SGD that were mounted on either side of the headrest of her wheelchair. Her right switch was programmed to select through options on her Tobii Dynavox with Communicator 5 installed and her left switch selected and activated speech output. Hannah had been using this setup up for over a year at the start of the study. Hannah also vocalized, used facial expressions and body movements, and changes in facial affect to communicate her wants and needs. Kevin was a White male who had completed graduate school. There were four total members of the family (2 adults and 2 children), their reported income was a little more than needed, and due to the pandemic, they opted out of using their PSW due to Hannah's health risks. Kevin and Hannah lived 120 miles away from the university.

Dyad 3 consisted of Diane (mother) and James (12 year old son). James was a White male diagnosed with Down syndrome who received special education, speech language therapy, occupational therapy, physical therapy, augmentative communication, and behavioral services at school. James used TouchChat installed on an Apple iPad and had been using his talker for over a year. James also vocalized words and short phrases, usually after modeling, and used gestures, modified signs, and bringing caregivers to desired items or activities to communicate his wants and needs. Diane was a White female who had completed college and reported household income as just enough to meet their needs. There were four members of the family in their household (2 adults and 2 children) and they lived 20 miles away from the university.

Table 1

Parent Characteristics

Dyad	Name	Relation to child	Race	Education	Household Income	Miles from University
1	Anne	Mother	White	College	Just enough	25
2	Kevin	Father	White	College	More than enough	115
3	Diane	Mother	White	College	Just enough	20

Table 2

Child Characteristics

Dyad	Name	Age	Race	Sex	Disability
1	Max	14	White	Male	Autism spectrum disorder
2	Hannah	8	White	Female	Other health impairment
3	James	12	White	Male	Down syndrome

Recruitment

Participants were recruited via direct referral from social media postings of the recruitment flyer, emailing flyers through professional connections (e.g. former colleagues and graduate student acquaintances of the researcher), and emailing flyers to local school district personnel (e.g. teachers of self-contained special education classrooms, speech-language pathologists). Anne and Diane were referred to the study by their school district augmentative communication specialist who had received the flyer from the researcher and Kevin was referred to the study by receiving the flyer from Hannah's classroom teacher. There were no geographic or distance requirements to participate in this study, which took place entirely via telepractice.

Each parent independently emailed the researcher expressing their interest in the study and completed screening via phone. The prospective parent interventionist answered questions about their child's age, disability eligibility and school services, type of SGD and familiarity with using the SGD, familiarity with using Zoom, and any potential concerns or issues (e.g. parent work schedule, child challenging behavior) that might arise during the course of the study. All three parents were very experienced in using Zoom software, utilized high speed wireless Internet connections on laptops (Dyads

1 and 2) or a mobile tablet (Dyad 3), and were proficient in modeling words and phrases on their child's device. Dyads 1 and 3 were not able to change vocabulary or pages on their child's SGD due to restrictions placed by each child's school. Dyad 2, Kevin, was not only able to change vocabulary and pages at will but was very proficient at doing so. Screening phone calls lasted about 10-15 min per parent.

Following screening, parents were each invited to participate on a Zoom call with the researcher to go over informed consent procedures and provide the parent with another opportunity to ask questions about the study goals, procedures, and outcomes. This Zoom call was also used to determine whether each family's technology and Zoom proficiency were adequate for participating in study procedures. All three dyads had adequate technology and Internet connectivity; Dyad 3 experienced connection interruption and slowdown during rainy weather and were mailed a tablet stand to enhance researcher view of the child and device during sessions during baseline. Dyads 1 and 2 did not experience or report any technology or connectivity issues during the study.

Information about the timeline, frequency and duration of sessions, and any further information about the study requested by parents were discussed on this initial Zoom call with the prospective parent and the researcher. Informed consent procedures were emailed to each parent via Qualtrics survey link and were verbally summarized by the researcher while the parent completed each survey. All three parents preferred online survey completion to filling out documents and emailing or mailing them to the researcher.

Following informed consent by the parent, each child was brought into the telepractice session, introduced to the researcher, provided with a brief description of

intervention procedures. Each child was asked if they wanted to "talk with teacher Becky twice a week". To the greatest extent possible, the child was asked to provide assent through natural speech, use of SGD, or idiosyncratic communication behavior which was interpreted by the participating parent (e.g. eye point, body movement, facial affect). Throughout study procedures, if any participant began to engage in challenging behavior and/or express frustration or distress (e.g. crying, attempting to leave the area/room, saying they don't want to talk anymore) for more than two consecutive sessions, this would have been interpreted as a withdrawal of assent and the participant and their parent/caregiver asked if they wish to end participation in the study or modify procedures. This initial Zoom call with the parent and child lasted an average of 30 min per dyad and was not recorded by the researcher. All three parents and children provided informed consent and assent to participate in the study and all three dyads completed all phases of research.

Non-interventionist family members and friends who participated in generalization probe video calls with the child also completed an online informed consent form indicating their understanding and granting permission for their voice and video images to be recorded and used for research purposes. All informed consent forms, emailed via Qualtrics survey, were reviewed and completed by each non-interventionist adult prior to their first generalization probe session.

Research personnel

The researcher was a biracial American (White and Japanese) doctoral candidate in Special Education and Clinical Sciences who was also a Registered Behavior Technician®. She earned a master's of education in early childhood special education

and severe disabilities. She taught elementary school special education for 6 years, 4 years of which were in a self-contained classroom for students with severe cognitive disabilities. She was an in-home applied behavior analysis verbal behavior therapist for 5 years and had recently completed a verified course sequence for earning Board Certified Behavior Analyst certification. She has worked as a babysitter and professional caregiver for children with severe disabilities, including children who use SGDs, and received informal training from licensed speech-language pathologists on setting up, programming, and using a variety of SGDs and AAC systems. She had previously designed and run a single case experimental design study teaching language matching to a multilingual individual who used SGDs at the university clinic before designing and implementing this project.

Settings and Materials

Parents worked with the researcher to select and determine optimal settings within each family's home for telepractice intervention for parent training and child intervention. The researcher encouraged the parent interventionists to find a quiet area within the home for intervention sessions and to find a location within the home that is usually used for family social interaction (e.g. kitchen table, couch). Each parent identified a table-top surface where online school and other learning activities regularly took place. Dyad 1 completed sessions with Anne and Max seated side-by-side at the dining room table facing the laptop with Zoom displayed, angled down to show Max's SGD and their hands for levels of prompting. Dyad 2 completed sessions with Hannah seated in her wheelchair with head switches mounted (scanner switch on her right, selector switch on her left), facing the laptop with Zoom displayed. Her father, Kevin, sat

next to her to provide prompting as needed and attend to her needs during sessions. Dyad 3 completed sessions seated at a table in their living room with Diane and James seated side-by-side in front of a Motorola G7 mobile tablet mounted on a researcher-provided tablet stand tilted to show James's SGD and their hands to show levels of prompting.

Parent training sessions took place at another location within each parent's home with the door closed to avoid inadvertently exposing the child to intervention procedures before intervention began. Dyad 1 (Kevin) demonstrated removal and return of Hannah's head switches with hand motions and Dyads 2 and 3 (Anne and Diane) used their child's SGD during parent training sessions to practice prompting and modeling responses.

The researcher conducted sessions in a quiet, private location within her home, initially using headphones or earbuds to minimize audio feedback and maximize microphone pickup of vocal-verbal communication. During intervention, the researcher discovered that audio quality of her vocal verbal output was clearest using her laptop computer microphone rather than BlueTooth™ earbuds and stopped using earbuds for the remainder of sessions. Due to Covid-19, no other persons were able to see or hear sessions; however, some sessions were interrupted by the researcher's cat, who was happily greeted by parent interventionists and pointed out to children. Figaro's audible and visual presence served as a motivating operation to evoke tacts (labels) and commenting about pets: Hannah was encouraged by Kevin to talk about her pets and independently expressed "I want to tell you about my pets" and activate a button programmed to name her cat, dog, and guinea pigs. James independently activated "meow" on his talker, smiled, and leaned toward the iPad displaying Zoom.

Hardware and Software

The researcher used a 13-inch 2016 Apple MacBook Pro™ with Touch Bar laptop equipped with 2.9 GHz Dual-Core Intel Core i5 processor, 8 GB of DDR3 RAM, an integrated Intel Iris 1536 MB graphics card, an integrated 720p HD webcam, and 802.11ac WiFi for audio-visual transmission of data during sessions. The researcher initially used wireless BlueTooth™ earbuds, specifically Apple Airpods Pro, but discontinued use after a month when she realized that sound quality was better using the MacBook's internal microphone. All sessions were recorded within Zoom and immediately transferred to the researcher's university-licensed password protected DropBox account, which was also HIPAA compliant. Selected videos for data collecting coding were shared with other students via their university-licensed password protected DropBox accounts. Session recordings were also backed up on a password protected LaCie 2 TB external hard drive connected via USB-C. This hard drive stayed within the researcher's home and was not accessible to any other persons.

All sessions were conducted using Zoom for Healthcare, which is HIPAA-compliant and provided to the researcher by the researcher's institution via enterprise license. Parent interventionist equipment varied but all met minimum technology and connection requirements of Zoom for Healthcare. Zoom software requires a minimum of the following computer hardware system and Internet capabilities: (a) 3G wireless connection, (b) speakers and a microphone, (c) internal or external web camera, (d) single core 1 GHz or higher processor, (e) 600kbps up/down for video calling, and (f) 50-75kbps for screen sharing. For generalization probes, the same session link, which was a recurring meeting that could take place any day and time, was shared with their family member or friend who also met minimum teleconferencing software requirements.

Telepractice sessions were initiated by the parent or the researcher using a recurring meeting link in Zoom that was valid for any day and time. Each dyad had a unique link and this single link was also used by Dyads 1 and 3 for generalization probes. All recorded videos were saved with the following filename: D#_######, e.g. D1_12.08.20 to indicate which dyad and session date. This was used to manage and assign videos for IOA coding; data collectors only had access to their assigned videos.

Intervention Materials

All materials were offered to parents via email, hard copy sent via USPS or drop-off. All parents opted for PDFs emailed to them and used electronic copies during sessions of the parent checklist and target questions. Diane in Dyad 3 opted to write down the target questions on index card for her own reference during the first 6 baseline sessions and did not use them during subsequent sessions. All informed consent, demographics information, and modified TARF-R forms were made available to parents via online Qualtrics survey; no parents requested documentation of completed forms or copies of items prior to completing each survey online.

Modified TARF-R ratings forms for the non-parent interventionists were completed online as a Qualtrics survey; this link was emailed to each parent to forward to the non-parent interventionists who completed generalization probes.

Measurement

Pre-intervention assessments

Following recruitment and prior to beginning baseline, parents were asked to complete the Parent/Caregiver Form of the Vineland Adaptive Behavior Scales (Vineland-3) Communication and Socialization domains via semi-structured interview

with the researcher over the phone. The Communication subdomain assesses the child's receptive, expressive, and written skills and the Socialization subdomain assesses the child's interpersonal relationships, play and leisure, and coping skills (Sparrow et al., 2016). The Vineland-3 is a normed assessment used for diagnosis, progress monitoring, and skill selection for individuals with disabilities across all ages and needs.

Parent interventionists also provided information to the researcher about the child's current intraverbal communication skills, guided by the Verbal Behavior Milestones Assessment and Placement Program (VBMAPP; Sundberg, 2008). The VBMAPP is a nonstandardized developmental assessment and curriculum used for targeting skills and progress monitoring. Parents were asked items in level 2 of the VBMAPP about their child's communication skills such as could the child complete fill in the blanks of songs and common phrases or answer what, who, and where questions. Parents were also asked items in level 3 of the VBMAPP regarding their child's spontaneously emitting comments and answering questions after being read short passages from books. Parents were provided with digital copies of questions for both the Vineland-3 and the VBMAPP assessments prior to each phone interview. Vineland-3 and VBMAPP scores for each child are presented in Table 3 as are each child's communication system.

Dependent variables

Parent use of strategies. Data were collected during each session on parent fidelity of implementing intervention strategies, measured by percentage of strategies completed independently during the parent-mediated trials on a procedural fidelity checklist created by the researcher (see Appendix B).

Table 3

Child Communication

Child	Vineland-3 Scores	VBMAPP Levels	Device	Access
Max	Communication: 85 Socialization: 71	Mand Level 2 Tact Level 2 Intraverbal None	TouchChat on iPad	Touchscreen
Hannah	Communication: 61 Socialization: 63	Mand Level 1 Tact None Intraverbal None	Tobii Dynavox Communicator 5	Head switches: scanner and selector
James	Communication: 36 Socialization: 68	Mand Level 1 Tact Level 1 Intraverbal None	TouchChat on iPad	Touchscreen

Note. Vineland-3 scores reported as domain-level standard scores. VBMAPP levels reported are levels that each child mastered fully.

Parent fidelity of implementation of the intervention was recorded by the researcher during each session. The total number of correctly completed steps on the checklist divided by the total number of possible checklist items x 100 was used to determine percent parent fidelity per session. Each session had a different number of possible items due to some items being not applicable such as error correction.

Child responding accuracy. The second dependent variable was number of questions answered correctly during researcher probe via Zoom. Each parent and the researcher developed four relevant questions to ask the child, such as "*What did you do today*?", "*What is your favorite movie*?", or "*Where did you go today*?". Child responses

using their SGD were defined as independent or prompted activation of the SGD. Correct responses were defined as a response that the parent deemed a contextually appropriate response to the question (e.g. "*What did you do today?"* and the child activated their SGD independently to respond "*Frozen 2"*. The parent either positively reinforced correct responses or completed error correction procedures, enabling the researcher to code correct or incorrect responding). Level of prompting was defined as which of the most-to-least prompts selected by the researcher and parent during parent training and were coded as 3, 2, or 1 for the most, less, and least intrusive level of prompting on each child's data sheet. The researcher coded child responding and level of prompting during each session. Parents did not take any data during sessions and were told each session's prompting level before beginning their teaching trials.

Child accuracy was reported as percent correct per session, calculated by number of questions answered correctly divided by the total number of questions asked x 100. During some sessions due to time constraints, not all four target questions were asked. Child accuracy of answering was coded for parent trials as well, but as the dependent variable of interest was answering questions over video calls, these data were not included in the measurement of this dependent variable. These data are available from the author upon request.

Social validity. The nonexperimental dependent variables were assessed through social validity measures and semi structured interviews of parents, caregivers, and family members participating in generalization videoconference calls. All nonexperimental data were collected after intervention ended, during the maintenance phase for each dyad. Separate interviews for parents and child were completed via Zoom to ask about

feasibility, acceptability, and effectiveness of the goals, procedures, and outcomes of intervention, complete modified Treatment Acceptability Rating Forms, Revised (TARF-R; Reimers & Wacker, 1988), and ask about any changes in social closeness between the child and their immediate and/or extended family members.

The child edition of the modified TARF-R provided four emojis for the child to communicate their opinion of the intervention and whether they would participate in a similar intervention again. The child form was emailed to each parent with brief instructions that completing the form was optional and the child could either use the emojis or their SGD to answer the questions. All three children completed the modified TARF-R with parent support using their SGD, gestures, or body movements. Each parent and non-parent interventionist chose to complete the modified TARF-R via online survey. Parent interventionists completed the modified TARF-R questionnaire on their home device while on a synchronous recorded video call with the researcher, who took notes on parent feedback. Examples of the parent and child modified TARF-R forms are provided in Appendix C and guiding questions for the semi-structured interviews are provided in Appendix D.

Independent variables. The primary independent variable was researcher mediated behavior skills parent training to teach parents to ask social intraverbal questions and use most-to-least prompting procedures and progressive time delay to prompt correct responses from their child. The secondary independent variable was a parent mediated intervention using individualized most-to-least prompting and progressive time delay with a child who uses an SGD to answer social intraverbal questions asked via telepractice software.

Research personnel training

Data on both parent and child dependent variables were collected during sessions by the researcher or after sessions by data collectors. Each data collector was a trained education undergraduate or special education doctoral student. Training consisted of whole group training over Zoom and followed a behavior skills training model: Following didactic explanation of the study aims and dependent variables via screenshare of the logic model and study design, the researcher modeled via thinkaloud how to code a 5 min exemplar video. During training, the group coded two more videos together and were coached as needed by the researcher. Exemplar videos included parent-child interactions using AAC from an unrelated study provided with permission for research purposes and selected baseline videos from this study. Each prospective data collector independently coded at least four 5-minute exemplar videos to achieve a minimum of 90% agreement with the researcher. All three data collectors reached minimum agreement with the researcher after coding an average of five 5-min videos (range 3-9 videos).

Interobserver agreement

Per single-case research design standards, a minimum of 20% of data points in each phase (e.g. baseline and intervention) must be coded for interobserver agreement (IOA) and the minimum standard for percentage agreement is 80% (WWC, 2020b). IOA of child response data were coded by trained graduate students. The researcher independently coded primary data following each intervention session; once all sessions were completed, the researcher ran a random number generator to select sessions for IOA. A trained graduate student data collector independently coded at least 33% of

session videos for IOA with researcher data collection of parent intervention fidelity and child correct responding. Reliability data for child and parent data were calculated for each session as follows: total number of agreements divided by total number of possible agreements x 100. Those results were averaged across all the sessions selected for IOA calculation to compute the average reliability between the researcher and the independent data collector for each dyad's parent and child data.

Reliability data for parent use of strategies was coded by an independent observer, one per dyad, completing the parent checklist for at least 36% (range 36-45%) of sessions selected by random number generator. Each session's agreement was calculated as follows: number of agreements divided by the number of total possible agreements. The average of each session's percent agreement for each dyad's reliability data is reported as the reliability for that dyad's parent data. IOA for parent use of strategies data collection were as follows for each dyad: Dyad 1 was 96.84% (range 91.67 – 100%), Dyad 2 was 97.27% (range 88.23 – 100%, and Dyad 3 was 94.01% (range 83.33 – 100%).

Session agreement was averaged for each child was also calculated for at least 40% (range 40-50%) of sessions, selected by random number generator. The reliability data coder watched each session and independently marked each child's responses during the researcher probes. Percent agreement for each child session were averaged to report agreement for each dyad. IOA for child data during the researcher probe were as follows for each dyad: over Dyad 1 was 92.5% (range 75 – 100%), Dyad 2 was 100%, and Dyad 3 was 93.75% (range 75 – 100%).

Researcher Treatment Fidelity

Because this intervention was parent-mediated, there were fewer sessions during which the researcher served as the interventionist. Researcher treatment fidelity was collected for 1 session comprising at least 3 attempts or trials for each parent and independently coded by a trained data collector. The data collector had also completed either child or parent reliability data collection for that dyad to ensure their familiarity with the imaginary role play of procedures. Researcher-mediated BST sessions with each parent interventionist were recorded and coded for researcher procedural fidelity for each parent training session. Trained data collectors completed procedural fidelity completing a 34-item task analysis checklist based on the researcher's BST script by taking the total number of correctly implemented steps divided by 34 x 100 to obtain a percentage of steps completed correctly. Researcher treatment fidelity was 100% for each of the three dyads, indicating the researcher completed all 34 items on the BST checklist during parent training.

Experimental Design

A concurrent multiple-baseline across participants single case research design was used to examine the effects of researcher mediated behavior skills training on a parent mediated intervention using most-to-least prompting and progressive time delay on answering intraverbal social questions by a child who used an SGD. During parent training sessions between baseline and intervention, BST was implemented by the researcher to train parents to fidelity on procedures of most-to-least prompting and time delay procedures.

Multiple-baseline across participants designs repeatedly measure behavior over time, stagger introduction of the intervention across participants in a time lagged fashion

to control for extraneous variables affecting internal validity such as other interventions and child maturation (Ledford & Gast, 2009). A treatment effect is determined by demonstrating that changes in behavior result from manipulation of the independent variable in comparison to the baseline condition. Multiple-baseline designs are best for interventions that cannot be withdrawn, such as teaching an individual a new skill that cannot be removed from their behavioral repertoire. Multiple-baseline across participants is the most commonly used single case research design in the research literature and demonstrates replication of an intervention effect across cases (Hedges et al., 2013).

Data Analysis

Determining within-case nonoverlap metrics and between-case effect sizes are tenable with multiple-baseline designs, providing an estimation of magnitude of effect for each participant and an omnibus standardized mean difference statistic that can be compared to results from other designs (Valentine et al., 2016). Between-case effect sizes and within-case effect sizes are not comparable; thus, each is calculated separately for the effects of parent mediated social intraverbal questions and most to least prompting with progressive time delay on child responding using an SGD. The nonoverlap effect size measure Tau-U was used to measure within case nonoverlap of adjacent phases for each dyad and the between case standardized mean difference (BC-SMD), Hedges *g*, was used to measure between case effect sizes. Visual analysis was used to determine demonstration of basic effects and functional relations.

Visual analysis

Determining a basic effect for each case and determining the extent to which a functional relation between the independent and dependent variables is done through

visual analysis of graphed data. Visual analysis examines within and between phase changes in level, trend, variability of data, immediacy of effect, consistency of data across similar phases and overlap of data across phases to determine whether a basic effect was demonstrated (Kratochwill et al., 2010). Vertical analysis to examine independence between tiers and demonstration of effect across tiers is also part of vertical analysis procedures for multiple-baseline designs. A minimum of three replications of the basic effect are required over three separate points in time with at least five data points in each phase to establish a functional relation. A stable, or predictable, baseline pattern that is changed due to manipulation of the independent variable is considered a demonstration of the basic effect (Horner et al., 2005).

Tau-U

Visual analysis is frequently supplemented in single case research design by non-parametric indices such as percent of non-overlapping data (Scruggs et al., 1987), non-overlap of all pairs (Parker & Vannest, 2009), or improvement rate difference (Parker et al., 2009). Tau-U was created to account for therapeutic baseline trend as well as change in level, is more resistant to autocorrelation than other indices, and can be used to compare intervention effects across single-case studies in a meta-analysis (Parker et al., 2011). Tau-U calculations for within-case assessment of parent strategy use and child response accuracy were completed using the online calculator (https://jepusto.shinyapps.io/SCD-effect-sizes) created by James Pustejovsky and Daniel Swan (2018).

Between-case standardized mean difference

Standardized effect size calculations that can be compared across studies and design types remain a barrier to establishing evidence-based practices across designs and reported outcomes. Group designs often report outcomes using standardized effect sizes but reporting effect sizes is a relatively new concept in single case research designs. Reporting standardized effect sizes also facilitates interpreting results in meta-analyses and establishing interventions as research-based (Valentine et al., 2016). Hedges' *g*, a *d*-statistic comparable effect size measure, is useful due to its being the same effect size metric reported by between-subjects designs and thus facilitating comparisons across studies and designs as well as in meta-analyses (Shadish et al., 2013). This effect size index has also been adopted by the What Works Clearinghouse Procedures Handbook, Version 4.1 for continuous outcome measures (WWC, 2020a). Design-comparable effect sizes for the effect of BST on parent implementation fidelity and for the effect of parent-mediated intervention on child responding using an SGD were calculated using the online calculator (https://jepusto.shinyapps.io/scdhlm/) created by James Pustejovsky (2016).

Overview of Experimental Phases

This study comprised four experimental phases: baseline, parent education and training, child intervention sessions, and maintenance. A pre-intervention assessment phase preceded the baseline phase. Generalization probes took place throughout each phase and consisted of the child using their SGD to answer intraverbal social questions asked by an untrained communication partner (a different family member or family friend). Generalization probes were conducted via Zoom and hosted by the researcher who blanked out her screen and did not participate in the conversations. Generalization probes were conducted in natural family routines of communicating across distance with

friends and family, with extended family members or family friends who received the child's target questions before the conversation. Parent interventionists were present to conduct 3 s time delay prompting and error correction procedures if needed.

Before and throughout all phases of the experiment, parents were coached and encouraged to use noncontingent reinforcement (NCR) of appropriate and desired behavior of the child for coming to the session area, such as remaining in the session area and on screen throughout the session, engaging with the researcher via videoconferencing software, responding to questions, tolerating prompting by the parent, and any other individualized targets identified by the parent. Initially, parents were encouraged to start with 30 s intervals of NCR and encouraged to try different types of rewards (social praise, physical touch, edibles, access to preferred toys). During baseline sessions, 30 s was too frequent and interrupted child responding using their SGD; parents were encouraged to praise the child for responding using the SGD, attempting to answer, and for talking with them and with Becky after each question. Examples of social praise provided by the parent to the child for engaging in intervention sessions included eye contact and smiling, telling the child "*You're doing so awesome*!", "*Good answer!*" and/or positive affectionate touch after the child responded to each question.

Pre-Intervention

Each parent was interviewed by the researcher to complete the Socialization and Communication subdomains of the Vineland-3 assessment (Sparrow, 2016), the mand, tact, and intraverbal portions of the VB-MAPP (Sundberg, 2008), and asked about any challenging behavior concerns. Parents were asked to collaborate with the researcher to select four social questions that extended family and friends might ask or have asked the

child, asked what prompts the parent found successful with communication and functional tasks, and asked what kinds of items or activities the child enjoyed to identify potentially reinforcing items or activities to deliver during and following intervention sessions. Each dyad's target questions and prompts are presented in Table 4. Intake sessions lasted 45-60 min and were conducted via Zoom.

Table 4

Target Questions and Prompt Levels

		Prompt Levels		
Child	Questions	Most	Less	Least
Hannah	What do you want to play? Can you tell me something about you? What do you want to drink?* Who is your best friend?*	Request category, remove and return scanner and selector switch for errorless responding	Request category, remove and return selector; scanner switch stays in place	Request category, one complete scan-through permitted
Max	Do you like holidays?* What have you been doing? What have you been learning?* Where have you been going?	Model answer	Near point to icon	Far point to device
James	How are you? What do you like? What did you play today? What movie did you see?	Model and say answer	Point to icon and say answer	Say answer

Note. Questions marked with * were changed during intervention. Hannah's questions were dropped due to fatigue during sessions. Max's questions were modified to reflect his dislike of holidays and remove the word "school" which was upsetting.

Baseline

Baseline sessions began after completion of informed consent and intake. Prior to the first baseline session, scheduling of the twice weekly sessions was established, and a recurring Zoom link sent to each parent via email. Each parent connected with the researcher via Zoom and confirmed that they had the questions, their child, and the child's SGD set up and ready. Each parent interventionist was asked to ask their child each of the four target questions twice, one after the other, providing two opportunities for the child to respond. Parents were instructed to wait approximately 3 s after asking the question before "doing what you usually do with [child] and their SGD". Dyads 2 and 3 were also coached to angle their Zoom screen so that the researcher had a clear view of the child's hands and their SGD screen. For Dyad 1, seeing Hannah's head movements and her head switches was more important than seeing her SGD screen and adjusting her Zoom device was not necessary.

Due to the staggered introduction of intervention across cases in a multiple baseline design, each dyad had different baseline lengths. The number of baseline sessions was assigned by random number generator: Dyad 1 for 5 sessions, Dyad 2 for 8 sessions, and Dyad 3 for 11 sessions. Case assignment to each tier was also randomized; however, this was modified during baseline. Dyad 1 was randomly assigned to be Kevin and Hannah but due to Hannah's medically-related scheduling needs, they became Dyad 2 and were in baseline for 5 probed (discontinuous) baseline sessions. Hannah became ill after the first two baseline sessions and missed 2 consecutive weeks followed by intermittently attending one session per week the following 3 weeks. Dyad 1 was then

assigned to Anne and Max, who completed 8 baseline sessions but began parent training sessions first. Anne and Max did not miss any sessions during winter break and completed their baseline sessions before any other dyad. Dyad 3 was assigned to Diane and James, who completed 11 baseline sessions and began parent training sessions last. Each dyad completed 2 sessions per week, with few exceptions for scheduling or medical needs. Dyad 1 missed 2 sessions on nonconsecutive weeks, Dyad 2 missed a lot of sessions during baseline but attended with much greater consistency during intervention, and Dyad 3 missed 2 weeks for winter holiday travel but otherwise attended very consistently.

Child responses were scored as correct or incorrect based on parent responding to the answer. If the parent's verbal behavior indicated that the answer was appropriate (e.g. *What do you like?* James: "I like moon." Diane: "That's right! You watched a show about the moon! The moon is so beautiful!"), the response was marked correct. Answers to target questions were not predetermined and children were permitted and encouraged through parent prompting to change their answers and respond with different topics.

After each question was asked twice by the parent, the researcher greeted the child and made an introductory comment (e.g. Hi! It's so nice to see you!"). During each session, the researcher made a personal connection to the child based on the target questions developed with the parent. For example, when asking James "What do you like?", Becky showed and talked about something she liked, most frequently her audible and visible cat, which greatly increased James's interest. Making personal connections and setting a context of common favorites was hypothesized to increase contextual and personal relevance, increase motivation for engaging with the researcher via video call,

and incorporate child interests to build shared experiences and establish a more natural context for asking the target questions. Other examples included Becky screensharing a photograph of her cat and a photograph of herself in a kayak to Hannah and showing the Moana video cover to Max.

The researcher asked each child the target questions and responded to child responses, prompted or independent. Parents were directed by the researcher prior to and during baseline sessions to "do what you usually do during video calls or when family talks to [child]." Following the researcher probe, the researcher and parent briefly debriefed about the session, discussed any questions or concerns, checked in on the next session day and time, and checked in on a generalization probe if warranted. Generalization probes were requested every 5-6 sessions but did not occur as often as desired.

Data on percentage of parent intervention strategy use of the fidelity checklist, percentage of prompted and independent child accurate responses, and level of prompting used by the parent for accurate child responding were coded by the researcher during each session. The researcher did not coach or provide feedback on strategy use during baseline sessions. Each video recording was immediately transferred from the researcher's Zoom folder on their computer hard drive to the password-protected DropBox folder.

Parent education and training

Following each tier's last baseline session, child sessions and data collection were placed on hold and researcher mediated BST parent training took place via Zoom. BST consisted of direct instruction and explanation of strategies and skills, modeling the skill,

rehearsing the skill, and shaping behavior through coaching and feedback (Miltenberger, 2011). Parents were emailed a PDF of an at-a-glance single sheet of simplified intervention procedures to use and refer to during parent training and intervention sessions prior to parent training. Parent treatment fidelity mastery criterion were achieving at least 90% accuracy on the parent checklist for three consecutive trials. Each parent practiced prompting their invisible child during each trial while the researcher coached and checked items off on the fidelity checklist. A sample BST parent training checklist, researcher script for BST parent training, and the at-a-glance parent visual are available in Appendix A.

Parent training took an average of 30-45 min per session. Dosage of parent training was 1-2 sessions, comprising 3-5 trials total. Anne of Dyad 1 achieved mastery of intervention procedures after 5 trials over 2 parent training sessions. Anne's average procedural fidelity was 91.6% (range 82-97%). Kevin of Dyad 2 mastered intervention procedures after three consecutive attempts with an average procedural fidelity of 97% (range 91-100%). Diane also achieved mastery after three consecutive attempts, achieving 100% accuracy on her first attempt during BST. Her average fidelity was 98.67% (range 96-100%).

Parents were encouraged to practice and review materials outside of sessions as they wish and had access to pre-recorded instructional modules created by the researcher on most-to-least prompting and time delay. The video modules were uploaded to private unpublished YouTube links which were emailed to parents prior to parent training; each parent stated they watched each module before the first parent training session. Video modules were recorded by the researcher and incorporated didactic slideshow lessons and

demonstrations of prompting strategies using a 4x4 grid of 2x3 inch photographs on the GoTalkNOW Lite app on an Apple iPad 2. Due to Covid-19 restrictions on social interaction, the researcher modeled hand-over-hand prompting with her own hands. Each 5 min video module was available to parent interventionists throughout the study to view as many times as they wish at their preferred time and pace and are still online. Both presentations are available in Appendix E and are available at the following links: Most-to-Least Prompting https://youtu.be/kG3WUY79_7I and Progressive Time Delay https://youtu.be/yFgZjivcAWQ

Child intervention

Child intervention sessions began after each parent achieved mastery criterion in parent training sessions. In the first 5 min of the first child intervention session, the researcher reviewed the level of prompting for each question, question asking and time delay procedures, ensured the parent has their checklist, and checked in about questions or concerns. Each parent expressed confidence in implementing intervention procedures and did not want to run through the steps prior to beginning the session with their child.

The first part of each intervention session were two practice trials between the parent and child. The parent asked each question, providing the most intrusive prompt with a 0 s time delay, then ask the question immediately after followed by a 3 s time delay. Each question will therefore be asked by the parent twice and the child will have two opportunities to practice responding. Parent-child prompting proceeded as illustrated in this example: Parent asked, “What’s your favorite food?” and immediately pointed to the correct answer (gesture prompt at 0 s time delay), eliciting the child’s correctly pressing “spaghetti” on the SGD. Parent immediately praised and rewarded the child and

asked the question again, “What is your favorite food?” and waited 3 s, providing the child with an opportunity to independently respond. If the child did not respond within 3 s, the parent pointed to the correct answer, the child pressed “spaghetti” and the parent provided praise. During this phase, the researcher observed over Zoom and provided coaching to the parent when needed.

After each question was asked, the researcher probe trial began. The researcher greeted and complimented the child (e.g. “I love your shirt! It’s so good to see you!”). The researcher asked each target question in a different sequence than the parent used, and the parent used a 3 s time delay. The child had an opportunity to respond independently but was prompted to successfully answer the question if independent responding does not occur within 3 s. Level of prompting for each question during the researcher probe matched the parent level of prompting: if the parent used a gesture prompt during their trials, the parent also used a gesture prompt if needed during the researcher probe. Because the child dependent variable of interest was answering questions on a video call, researcher probe data was the terminal child metric rather than child responding during the parent practice trials.

Criterion for progressing from the most intrusive prompt to a less intrusive prompt was three independently or prompted correct responses at the 3 s time delay for each question asked by the researcher. Each child had at least three sessions at each level of prompting before moving to a less intrusive prompt. Mastery criterion for each question was three correct independent or prompted researcher probe responses at the least intrusive level of prompting. When all target questions met individual mastery criterion, the child mastered the intervention and enter the maintenance phase.

During each telepractice session, the researcher collected data on parent fidelity and provided feedback on correctly implemented steps and provided coaching on any incorrectly implemented or omitted steps on the checklist at the end of each session. Positive social praise for steps completed and gains in skill demonstration from last session were provided first, followed by constructive feedback on areas of need, if applicable. Constructive feedback focused on any missed or incorrectly implemented steps on the intervention checklist: "*The second time that you ask the question, remember to count to 3 before showing him the answer."* If parent fidelity fell below 85% accuracy for two or more consecutive sessions, the researcher re-trained the parent on missed steps until the parent achieved at least 90% accuracy for two consecutive trials. None of the participating parents' procedural fidelity was below 90% for two consecutive sessions.

Maintenance

Maintenance of child responding using an SGD to answer social intraverbal questions was evaluated at 2 and 4 weeks after the last intervention session. Maintenance sessions were researcher probe only: the researcher asking each of the four mastered questions via Zoom and the parent providing the least intrusive prompt or error correction if needed on a 3 s time delay. After completion of the last maintenance session, parent interventionists were given the option of researcher mediated BST of other parents/caregivers/family members on intervention procedures to increase generalization of the skills across communication partners and facilitate both maintenance and generalization of the child's newly acquired skills.

Debrief

Following child mastery of answering social intraverbal questions using their SGD, a debriefing session took place via Zoom with the parent interventionist and other caregivers and/or family members who wished to complete social validity measures and provide feedback about the intervention. Parent interventionists and child participants were asked to complete a modified TARF-R ratings form survey online, either via a conversation with the researcher on Zoom or independently. Semi-structured interviews with parent interventionists, child participants, and other caregivers and family members regarding social validity, feedback on the intervention, and changes in social closeness took place during this session. Each interview took place individually except the child interview, during which the child was supported by their parent during their interview. Sample questions used to guide the researcher's conversation with each parent are available in Appendix D.

CHAPTER III

RESULTS

Experimental Dependent Variables

Parent strategy use

Each parent demonstrated a within-case basic effect, supporting a functional relation between researcher mediated behavior skills parent training and parent use of most-to-least prompting and progressive time delay strategies. During baseline sessions, each parent implemented intervention strategies at very low levels. Anne correctly used intervention strategies at an average of 25% (range 17-31%), Kevin used strategies at an average of 27% accuracy (range 19-36%), and Diane completed steps of the intervention at an average of 22% (range 14-30%). During parent training sessions, each parent immediately demonstrated a large increase in use of intervention steps after parent training consisting of didactic instruction, researcher demonstration, and repeated parent role-play of strategies.

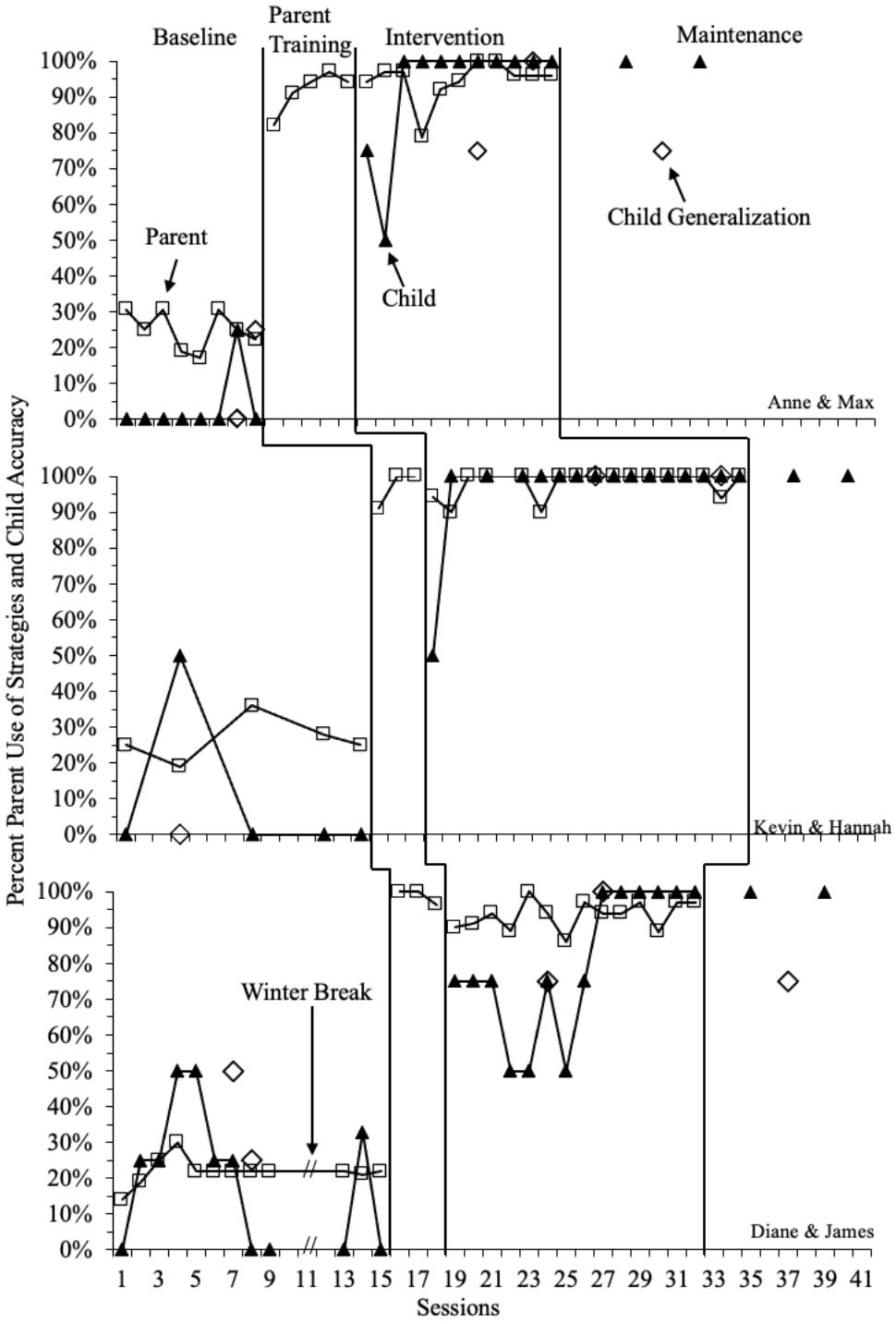
All three parents maintained high levels of accurate strategy use throughout intervention sessions: Anne used strategies at an average of 94% accuracy (range 82-100%) across parent training and intervention sessions, Kevin implemented the intervention with an average of 98% accuracy (range 90-100%), and Diane used intervention strategies with an average of 94% accuracy (range 86-100%). Anne's procedural fidelity was 79% for a single session due to not immediately prompting Max the first time each question was answered; she was waiting for him to respond independently. Her procedural fidelity the following session was 92% following pre-session coaching and did not fall below 90% for the remaining intervention sessions.

Kevin's overall procedural fidelity remained extremely high throughout all sessions and was never below 90%. Diane demonstrated more variability with intervention implementation, mostly around remembering the time delay procedures, and she was coached at the start of each session to immediately prompt the first time and wait 3 s the second time. Her procedural fidelity fell below 90% twice on two non-consecutive sessions, to 86 and 89% respectively, but remained high overall. Parent use of intervention strategies is shown in Figure 1.

Visual analysis of parent use of intervention strategies indicates three demonstrations of the basic effect: Anne, Kevin, and Diane's data paths show strong immediacy of effect, no overlap across phases, very little variability, and large changes in level and trend from baseline to intervention phases. In baseline, Anne and Kevin demonstrated decreasing level and trend with large changes during intervention. Strategies that each parent consistently used during baseline sessions included: having their child and their SGD ready at the beginning of each session, asking each question once, and responding to their child's answer. Items that were not demonstrated during baseline included following the prompt hierarchy, providing praise at the end of the parent trials, and completing progressive time delay sequences for each question. Vertical analysis of parent strategy use across cases indicates no potential threats to internal validity (e.g. no therapeutic trend in baseline when the intervention was implemented with a case above) and consistent changes in trend and level and very strong immediacy of effect when parent training sessions occurred.

Figure 1

Parent Use of Strategies and Child Response Accuracy



Each parent maintained very high levels of strategy use across child intervention sessions with slight variability in Anne and Diane's performance. Each parent's performance demonstrated a basic effect, supporting a functional relation between telepractice researcher mediated BST and parent use of intervention strategies. Parent training lasted for 1-2 sessions consisting of multiple trials of the parent role-playing intervention procedures. Each parent achieved at least 90% accuracy on each of three consecutive attempts within the second training session. Anne of Dyad 1 achieved mastery of intervention procedures after 5 trials over 2 sessions. Anne's average procedural fidelity was 91.6% (range 82-97%). Kevin of Dyad 2 mastered intervention procedures after three consecutive attempts during a single session with an average procedural fidelity of 97% (range 91-100%). Diane also achieved mastery after three consecutive attempts during a single session, achieving 100% accuracy on her first attempt during BST. Her average fidelity was 98.67% (range 96-100%).

Child accuracy

Per convention in single-case research design, three demonstrations of basic effect support a functional relation between parent use of most-to-least prompting and progressive time delay strategies on an increase in child accuracy of answering social intraverbal questions using a speech generating device. During baseline, each child answered four target questions with 50% or less accuracy. Max answered questions with an average of 3% accuracy during baseline (range 0-25%), Hannah answered questions with an average of 10% accuracy (range 0-25%), and James answered questions with an average of 19% accuracy (range 0-50%). Following parent training, each child demonstrated an immediacy of effect and a large change in level and trend. Max

answered questions during intervention with an average of 97% accuracy (range 50-100%), Hannah answered questions with an average of 90% accuracy (range 50-100%), and James answered questions with an average of 80% accuracy (range 50-100%). Child accuracy of answering social questions asked by the researcher is shown in Figure 1.

Visual analysis of child accuracy of answering intraverbal questions during the researcher probe support a functional relation between parent use of most-to-least prompts and progressive time delay and accurate answering of social questions on a video call. Max had extremely low levels of accuracy during baseline and parent training began after he did not give any correct responses during the 8th session. Once intervention began, Max immediately increased accuracy with some initial variability across sessions. During the third intervention session, he achieved 100% accuracy which maintained across decreasing parent support until he mastered intervention 8 sessions later. Max mastered the intervention during 10 sessions and maintained 100% accuracy across his four target questions during maintenance probes. Averages of child accuracy of answering social questions during the researcher probes are presented in Table 6.

Hannah also demonstrated very low accuracy in answering her target questions during baseline; she had a decreasing trend over 5 probe sessions. Her baseline data reflects those two target questions only. Hannah demonstrated immediacy of effect in the second intervention session and maintained responding during the researcher probe with 100% accuracy for the remainder of intervention sessions. Hannah mastered the intervention targets during her 15th intervention session.

James's accuracy in answering his four target questions demonstrated more variability and overlap than the other two participants. During baseline, James's response

accuracy ranged from 0-50%. His baseline sessions were interrupted for 2 weeks due to winter break and a family vacation. When he returned from vacation, his baseline pattern of responding was consistently low for 3 consecutive sessions prior to parent training. When child intervention sessions began, James demonstrated an immediacy of effect that decreased in the fourth and fifth intervention session, possibly due to his school augmentative communication specialist programming new vocabulary on his device. James responded to all four questions with the same answer, "Bible stories", which was coded as accurate to answer "What do you like" and "What did you play today". He therefore demonstrated overlap of 5 data points: 2 baseline and 3 intervention sessions resulted in 50% accuracy. James's accuracy increased to 100% during the 10th intervention session and remained at 100% through the remainder of sessions. James mastered the intervention during his 14th session. James also maintained 100% accuracy in responding during both maintenance probes.

During baseline, Max exhibited some challenging behavior that increased in frequency across sessions. When asked each question by Anne, he loudly vocalized "no no no", made high pitched noises, looked distressed, moved his hands rapidly, and reached for Anne's hand for support. Anne explained that outside events, especially changes in the home and schedule due to winter holidays, were very distressing for Max in addition to his unease of not knowing how to respond to the target questions. The researcher used a virtual background image depicting one of Max's favorite movies (Elf, Moana), kept sessions as short as possible, minimized social chatting, and praised Max for use of his device if his answer was incorrect during baseline sessions.

Each child mastered the intervention targets, defined as answering all target questions accurately during the researcher probe at the least intrusive level of prompting for 3 consecutive sessions. Because Hannah's session stamina required reducing the number of questions, her mastery criterion was answering both questions correctly rather than all four. Average intervention dosage, calculated as the mean of each child's number of sessions in intervention, was 13. Max spent 8 sessions in baseline and 12 sessions in intervention for a total of 20 sessions. Hannah had 5 discontinuous baseline sessions followed by 15 intervention sessions for a total of 20 sessions. James spent 11 sessions in baseline and 14 sessions in intervention for a total of 25 sessions. Max's sessions lasted a mean length of 13 min (range 14-18 min), Hannah's sessions lasted on average 23 minutes (range 19 – 33 min), and James's sessions lasted an average of 22 min (range 19 – 25 min).

Table 5

Number of Sessions by Intervention Phase

Dyad	Participants	Baseline	Parent Training	Intervention
1	Anne and Max	8	2	12
2	Kevin and Hannah	5*	1	15
3	Diane and James	11	1	14

Note. Hannah's baseline sessions were conducted discontinuously due to illness.

Generalization probes

Generalization probes were requested by the researcher every 5-6 sessions but due to scheduling challenges and parent forgetfulness occurred less often. Generalization probes occurred twice during baseline and twice during intervention phases for Dyads 1 and 3 and occurred once during baseline and twice during intervention phases for Dyad 2. Max completed generalization probes with his older sister and personal support worker calling him on Zoom when not at home. Hannah's generalization probes were embedded in her weekly overseas videoconferencing call to her grandmother. James had Zoom calls with his older sister and his nephew who lived out of state. The trained parent interventionist was present during all generalization probes and provided prompting and error correction as necessary. Overall, generalization probe accuracy was similar to researcher probe accuracy; however, Max answered generalization probes slightly less accurately (75% and 100%) than researcher probes (100% accuracy). A single generalization probe also occurred during the maintenance phase for Dyads 1 and 3; Max answered questions with 75% accuracy and James with 75% accuracy. Hannah did not complete a generalization probe during maintenance due to changes in her online school schedule.

Tau-U

Within-case nonparametric effect size calculations for parent use of strategies and child response accuracy using the baseline trend corrected Tau-U metric indicate little to no overlap between adjacent phases for each. Tau-U results for parent use of strategies indicate little to no overlap between baseline and intervention phases: Anne (1.00), Kevin (0.94), and Diane (1.00), supporting the results of visual analysis and demonstration of strong basic effects. Tau-U results for child accuracy of answering social intraverbal

questions during researcher probes on Zoom indicated little to no overlap between baseline and intervention phases as well: Max (0.91), Hannah (1.01), and James (1.00). These results were supported by visual analysis and demonstrate strong basic effects. The internal replication of intervention effectiveness across parent and child dependent variables indicates a strong functional relation for each, which supports the results of visual analysis.

Effect Size Calculations

To summarize overall intervention results and facilitate future inclusion of this study in systematic reviews and/or meta-analyses, the between case-standardized mean difference was calculated, providing an overall and design comparable effect size. The Tau-U nonoverlap index and effect size calculation results are reported in Table 6.

Table 6

Summary of Results by Participant

Dyad	Participant	Baseline *M* (%)	Intervention *M* (%)	Tau-U
1	Anne	27	98	1.00
	Max	3	90	0.91
2	Kevin	25	94	0.94
	Hannah	10	97	1.00
3	Diane	22	94	1.00
	James	19	80	1.00

Note. Tau-U values $p < 0.05$.

Between Case-Standardized Mean Difference

Design-comparable effect sizes for each dependent variable was calculated and reported as Hedges' *g* due to the small sample size and use of a multiple baseline design. The BC-SMD for parent use of strategies is 13.60, indicating a very large effect size. A very strong functional relation between researcher mediated BST and an increase in parent use of prompting strategies is supported by visual analysis, Tau-U, and BC-SMD.

The BC-SMD for child accuracy of answering social questions on a video call is 4.09, indicating a very large effect size. These data reflect a difference of almost four standard deviations between the children's accuracy of responding in baseline and their accuracy during intervention. A strong functional relation between parent prompting strategies and an increase in accurate child responding to social questions is supported by visual analysis, Tau-U, and BC-SMD.

Unanticipated findings

Response variability

Each dyad's target questions were selected to have multiple appropriate answers. Answers either changed with different activities ("Where have you been going?", "Did you watch a movie?"), changing child preferences ("What do you like?", "What do you want to play?"), or setting events ("How are you?"). Each parent provided verbal prompts suggesting answers each child could pick ("What have you been learning? You've been working on your math, some writing, and typing", "What did you play today? I saw you had your blocks out, and some books were on the table"). Max responded with the answer modeled or suggested by his mother, Hannah independently selected her answer after being prompted into the correct vocabulary category in her SGD by her father, and

James often responded with a response that had been modeled or spoken by his mother. The number of different answers given by each child to each target question are presented in Table 7. Hannah, who had 7 options to choose from within her *Play* vocabulary page, had 3 options that led into further options, e.g. *Play->Board games ->Mermaid Island.* This results in her having 10 possible different correct responses to the question "What do you want to play?" She also had a "home button" on each page which spoke *Beginning* and then clicked to the home page of her SGD; this response was marked as an error and triggered error correction procedures.

Reciprocal Communication

During each session the researcher noted down whether the child asked a question or greeted the researcher and what the child expressed to calculate the number of different utterances each child emitted using their SGD unrelated to the target questions. Max did not spontaneously greet or ask question of the researcher despite parent prompting. When asked by his mother, Anne "Do you want to ask a question?" he responded with distressed vocalizations, an agitated facial expression, and rapid hand movements, to which Anne responded, "That's ok, you don't have to, that's fine". Hannah greeted and spontaneously asked questions of the researcher 10 times across all sessions (baseline and intervention), comprising 6 greetings (e.g. *Hey, what's up with you?*) and 4 questions (e.g. *Do you have any pets?*). During all sessions, James pressed *How are you?* on his SGD 10 times after answering "How are you?" asked by the researcher and also asked *What flavor do you like?* after answering *I like chocolate ice cream* when asked "What do you like?".

Table 7

Response Variability to Each Target Question

Child	Question	Number of Different Responses
Max	Do you like holidays?	2
	What have you been learning?	2
	Where have you been going?	4
	What have you been doing?	3
Hannah	What do you want to play?	10
	Tell me something about you	6
James	How are you?	7
	What do you like?	7
	What did you play today?	8
	What movie did you see?	6

Increase in Independent Responding

Intervention mastery criterion combined prompted and independent responding within the definition of a correct child response. Prompted and independent responses were coded during in vivo data collection by the researcher to determine whether independent child responding increased during sessions. Data were collected across both parent trials and the researcher probe and are presented in Figure 2. In baseline, Max demonstrated very low levels of prompted responding due to Anne's not providing prompts and low levels of independent responding (range 0-25%). In intervention, Max increased independent responding with a large change in level during intervention session 5 when he for the first time demonstrated 100% independent responding. For the

remainder of intervention, his percent of independent responses was 75-100%. Hannah of Dyad 2 demonstrated very low percentages of independent and prompted responding during baseline. Once intervention began, she demonstrated a large immediacy of effect for prompted responses, which remained very high throughout intervention. Her highest percentage of independent responses, 50%, occurred in her twelfth intervention session, but throughout intervention remained at low levels (range 0-33%). James of Dyad 3 demonstrated low levels of independent responding in both baseline and intervention conditions (range 0-10%). James' accuracy with prompted responding was low during baseline (range 0-75%) and demonstrated a small immediacy of effect once intervention began with an increasing level and trend. James demonstrated higher levels of prompted responses as intervention progressed (range 25-100%). Both Hannah and James answered target questions correctly with parental prompts whereas Max demonstrated independent responding as intervention progressed.

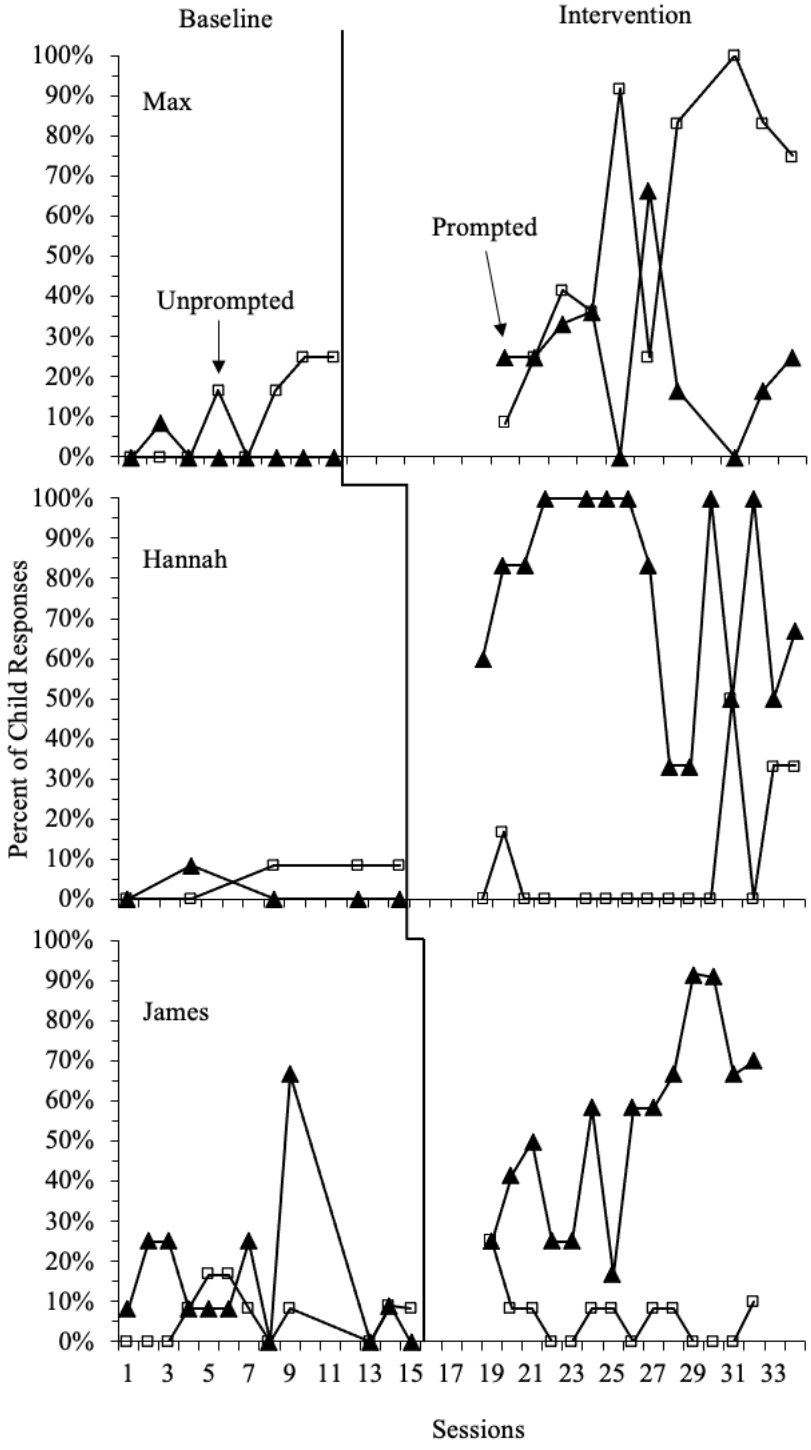
Nonexperimental Dependent Variables

Parent Interventionist Social Validity

Parent interventionists completed the modified TARF-R via online Qualtrics survey. Overall results of all three parents combined are reported in Table 8, enumerated with 1 assigned to the most negative rating response and 5 the most positive rating response. Overall, all three participating parents viewed the intervention favorably, stating they would recommend it to others, didn't find it very disruptive to their family routines, and found it definitely resulted in positive lasting changes in their child's skills.

Figure 3

Percent Prompted and Independent Responses by Each Child



All three parents stated that they didn't find the intervention resulted in lasting positive changes in their own skills, they did not find scheduling sessions or participating in sessions to be difficult, and the intervention increased positive interactions between themselves and their child. Parents also reported that the intervention resulted in an increase in positive interactions between their child and others over Zoom and they would definitely continue arranging video calls between their child and others.

Anne of Dyad 1 reported that her son, Max, experienced a lot of discomfort during the sessions. She explained that during baseline, he was very anxious and nervous before each session and was agitated and stressed as baseline sessions continued without his receiving any support. She reported that when intervention began and she was prompting Max, his discomfort noticeably decreased before and during sessions.

Each parent reported that they had been working on prompting, wait time, and modeling responses with their child's SGD for years. Anne of Dyad 1 felt that although she was familiar with prompting and wait time, it was helpful to wait a pre-determined amount of time, during which Max surprised her with his proficiency with independently answering. She reported that this was the most important takeaway for her and that she will continue to wait a couple of seconds before reaching over to prompt Max. Kevin of Dyad 2 explained that although he didn't feel that he learned any novel procedures related to working with Hannah and her SGD, the time that he and the researcher spent developing and defining the prompting levels was the most important takeaway from their participation. He reported that he had shared the prompt hierarchy with Hannah's school educational team and her private speech pathologist. The prompt hierarchy was now part of her individualized education program and that in private speech sessions, the

speech language pathologist was using the prompt hierarchy when introducing new communication skills. Diane of Dyad 3 also reported that prompting and wait times were not new information for her as she had been prompting James since he was a year old, but that consistently providing wait time was very eye-opening for her. She hadn't been providing consistent wait time before prompting and learned that James responded independently more frequently during the 3 s time delay.

All three parents stated they would continue to arrange video calls for their children. Anne of Dyad 1 reported that they didn't schedule calls with other family or friends as often as they'd prefer but that she noticed Max was more willing to greet and answer questions during school and related services video calls. She said that she planned to begin asking Max who he wanted to call and supporting him in social video calls using the prompt hierarchy we'd developed. Kevin of Dyad 2 stated they would continue to have weekly video calls with family overseas and that he'd noticed Hannah responded faster and with less wait time to social questions other than the target questions. He reported that the study provided Hannah with frequent, consistent, but short sessions to practice moving through the categories in her SGD, resulting her responding much faster during routine activities and social chats. Diane of Dyad 3 reported that prior to the study, she could not get James to look at or respond to video calls: She wasn't certain he understood that there was someone talking to him. During the study, she observed that he began looking at the video call screen, responding to the speaker, and she thought he gained an understanding that this was an interactive conversation rather than a movie. Diane shared that this was the most exciting and most important skill James learned by participating in the study.

Scheduling and flexibility were emphasized by all three parents as a significant strength of this study. All three parents reported that the researcher's flexibility with rescheduling sessions, accommodating last-minute changes, and fitting sessions within family routines was the main contributor to their completing the study and being able to consistently attend sessions. Kevin of Dyad 2 was particularly appreciative of the flexibility, reporting that they don't attend half of in-person speech sessions or school meetings. Having flexibility within days and across weeks was the primary reason that they were able to attend sessions as often as they did. He found the flexibility most useful for capturing Hannah's communication skills at their best, determine the best times of day for her, and accommodate the unpredictability of her daily needs. His reporting that they would probably participate in future studies similar to this and would recommend this type of study to others would be contingent on whether the flexibility of scheduling and moving days and times would still occur.

Child Social Validity

Each child participant was offered the opportunity to complete a modified visual TARF-R as well. Max in Dyad 1 completed the TARF-R in a conversation with Anne and circled answer choices on an iPad. Out of the four choices available, he indicated he did not at all enjoy talking with the researcher, did not like mom helping him with the questions, and would not like to have video calls with other people. He concluded his response by saying he was stressed because "mom was not helping". Hannah did not complete the modified TARF-R. James completed the modified child TARF-R as a hard copy printed out by his mother, Diane, who read the questions to him. James circled his answers and Diane transcribed what James expressed using his SGD.

Table 8

Social validity responses on modified TARF-R items

Modified TARF-R item	*M* response rating
Scheduling sessions	5
Willing for future studies	4.33
Recommend to parents	4.33
How much time required	2.67
Effective for child	4.33
Continue video calls for child	5
Disruptive to family schedule	2
Positive changes in child skills	4.67
Positive changes in parent skills	3.67
Discomfort during sessions	2.67
Positive interactions between parent and child	4.33
Positive interactions over Zoom	4.33

Note. Modified TARF-R ratings were from 1-5.

He circled the smiley face for all of the questions, indicating that he liked talking with the researcher on video calls, liked his mom helping him to answer the questions, and would like to have calls with other people. He answered "I like to talk" as his favorite part of the video calls and independently wrote his name at the bottom of the page, which was photographed by Diane and emailed to the researcher.

Non-Parent Interventionist Social Validity

Family and friends who completed generalization probes were invited to complete an online modified TARF-R questionnaire about their experience with the study procedures, whether they thought the intervention was helpful to the child and the parent, and whether they would recommend this type of project to others. Max's generalization probes were completed by two different familiar people, two by his older adult sister and two by his personal support worker (PSW). Only his PSW completed the survey because his sister completed baseline generalization probes but did not participate in generalization during intervention or maintenance. Max's PSW found the intervention procedures fairly acceptable, would recommend the project to others, and thought the intervention was moderately effective in increasing Max's skills with his SGD. She thought that the intervention probably resulted in lasting positive changes for Max but might not for his mother, Anne. Hannah's generalization probes were all completed by her grandmother, who lived overseas and was already video calling Hannah at least once per week for an average of 30 min per call. Hannah's grandmother did not complete the social validity questionnaire. James's generalization probes were completed by his older sister and his nephew, who each asked the target questions during their respective Zoom calls. James's nephew completed James's maintenance generalization probe. Despite three requests by the researcher, they did not complete the social validity questionnaire.

Summary of Results

Research Question One: Is there a functional relation between telepractice parent training using behavioral skills training and an increase in average parent intervention fidelity of parent mediated most-to-least prompts and progressive time delay?

All parents demonstrated very low implementation of intervention procedures during baseline (M = 25.33%) and high procedural fidelity of intervention procedures during parent training and child intervention sessions (M = 95%). Each parent demonstrated immediate changes in level and trend during parent training and maintained very high levels of implementation throughout intervention. The results of Tau-U calculations for each dyad and visual analysis support a functional relation due to three demonstrations of basic effect of researcher mediated BST on parent implementation fidelity. Design-comparable effect size calculations indicated a statistically significant very large effect for the effects of telepractice parent training on parent use of strategies.

Research Question Two: Is there a functional relation between an increased level of parent mediated most-to-least prompts and progressive time delay and an increase in level of child's prompted and spontaneous use of an SGD to respond to intraverbals on a videoconference call?

Average child accuracy of answering social intraverbal questions during a research probe video call was very low during baseline sessions (M = 10.67%) and immediately increased once parent mediated child intervention began (M = 89%). Each child demonstrated immediate changes in level and trend during intervention sessions and maintained high levels of accuracy throughout intervention and maintenance. The results of Tau-U calculations and visual analysis for each dyad support a functional relation based on three basic effects of parent mediated prompting procedures on child response accuracy of answering social intraverbal questions with their SGD on a video call. Design-comparable effect size calculations indicated a statistically significant very large

effect for the effects of parent systematic prompting and child accuracy of answering social questions over Zoom.

Research Question Three: How does a parent mediated intervention change social closeness and increase positive interactions between children who use AAC and their parents and extended family members?

All three parents reported an increase in positive interactions between themselves and their children as a result of this intervention. All three parents were pleasantly surprised at how quickly their children began correctly answering the target questions. They were also very pleased by their children's experiences during video calls with family and friends and all three parents plan to continue arranging video calls for their children.

Max of Dyad 1 and James of Dyad 3 completed the child modified TARF-R questionnaire. Max indicated that he did not enjoy sessions, talking with the researcher, and did not want to video call other people. He circled the second to worst emoji, which depicted a half-frown, for those items. James circled the second to best emoji, which depicted a smiling face, for those items and added that he liked to talk was his favorite part. Hannah did not complete the child modified TARF-R ratings form but during sessions with the researcher was alert, vocalized, smiled, and sometimes laughed.

Research Question Five: How do participating parents perceive the feasibility, acceptability, and effectiveness of a parent mediated intraverbal intervention delivered via telepractice to increase responding by their child who uses an SGD during a videoconference call with their relative?

Overall, parent ratings of feasibility, acceptability, and effectiveness were high. All three parents reported finding the intervention helpful for their children to learn to answer social questions, thought that their children had gained skills and become more comfortable with interacting over Zoom, and were very pleased that their children were demonstrating an increase in communication skills with other people over Zoom. All three parents reported being happy with the outcomes of the intervention, felt that the parent training and coaching were very effective and they each felt very comfortable with coaching, and that they will use the prompting hierarchy and wait time with other communication targets.

Research Question Six: How do family members not participating in the intervention and other non-participating family members perceive the feasibility, acceptability, and effectiveness of a parent mediated intraverbal intervention to increase responding by their child who uses an SGD during a videoconference call with their relative?

A single response to the non-interventionist modified TARF-R reported finding the intervention helpful and effective in helping the child learn new skills, they would recommend the study to others, and they found the procedures fairly acceptable. This response was from the communication partner for Max's intervention generalization probes.

Research Question Seven: Are there positive effects of participation in a parent mediated intraverbal intervention regarding continued social interactions and communication exchanges between communication partners and children who use SGDs at 2 and 4 weeks post-intervention?

All three children maintained accurate answering of their target questions at levels much higher than baseline at 2 and 4 weeks following their last intervention session. Max, Hannah, and James answered each of their target questions with 100% accuracy on a video call with the researcher. There were positive effects regarding continued social interactions reported by each parent, who planned to continue scheduling video calls for their child.

CHAPTER IV

DISCUSSION

This study evaluated the effect of researcher mediated telepractice BST and coaching on parent implementation of systematic prompting strategies to increase child accurate responding to social questions using a speech generating device while on video calls. Two dependent variables, parent use of strategies and child accurate responding during the researcher probe, were evaluated. This study also sought to assess acceptability and feasibility of telepractice-based parent training. All three dyads demonstrated a strong functional relation between their interventions and changes in behavior. Parents demonstrated high intervention fidelity during and after researcher-mediated behavior skills training, which in turn led to large, maintained changes in accurate child responding to social intraverbal questions on video calls. In this section, study findings and limitations are discussed and recommendations for future research are presented.

Effectiveness of Intervention

This study utilized researcher-mediated BST on parent use of prompting strategies during parent practice trials. Each session began with the parent asking each target question twice, first immediately prompting and then waiting 3 s to provide their child with an opportunity to independently respond. Parent training occurred in 2 or fewer sessions via Zoom and resulted in immediate large changes in parent use of strategies. Each parent mastered intervention strategies within 5 attempted trials and maintained very high treatment fidelity throughout child intervention sessions. Parents also reported that use of and adhering to systematic prompts improved their confidence during

sessions, provided opportunities for them to wait before immediately prompting their child, and resulted in their learning that their child can be successful and more independent than anticipated.

The second level of intervention was a parent-mediated intervention combining most-to-least prompting and progressive time delay to increase accuracy of child responses to social intraverbal questions asked via video call. Each parent implemented intervention steps with high fidelity, consistently providing prompts and wait time to their child during each session. Parents reported high levels of satisfaction with the intervention's effects on child responding, stating that they were pleasantly surprised that their child learned to give a variety of answers within a short period of time. Parents also reported high levels of satisfaction with providing wait time to their child to allow for independent responding while also being able to support and prompt their child when needed.

Telepractice Intervention Literature

The positive findings of this study extend telepractice intervention literature in several meaningful ways. First, this study contributes to the growing body of research supporting the use of telepractice technology to provide medical and behavioral care, coach and supervise practitioners and caregivers, and deliver individualized, intensive interventions directly into family homes (Ferguson et al., 2019; Tomlinson et al., 2018; Unholz-Bowden et al., 2020). Due to social distancing and research restrictions during the global Covid-19 pandemic, access to special education and related services were delivered via telepractice, often through direct instruction of children with IDD (Frederick et al., 2020). In the current study, providing support, training, and coaching to

parents to effectively implement intervention procedures helped each participating parent reach high levels of procedural fidelity, which in turn resulted in large increases in their child's accurate responding to social intraverbal questions.

The current study extends previous literature that explored the use of distance technology to increase child communication by expanding child responding beyond pre-determined or scripted responses, implementing intervention in natural settings with natural change agents, and conducting generalization probes with family or friends of each child. The current study also extended this research to individuals with disabilities other than ASD (Brodhead et al., 2019), incorporating an adolescent with ASD and two children with very different disabilities, all of whom use AAC.

Further, the current study is the only study to combine telepractice intervention delivery with parent training to increase social communication of children who use AAC. To date, there are two published studies investigating increasing social communication skills of children who use SGDs. In 2015, Lorah and colleagues reported using a 5 s time delay to teach two children with ASD to answer intraverbal statements about personal information using Proloquo2Go on an iPad (Lorah et al., 2015). In 2016, Carnett and Ingvarrson published a single case investigation of increasing intraverbal responding of a single child with ASD to emit a single, scripted mand for information on an SGD (Carnett & Ingvarsson, 2016). These studies, published over 5 years ago, remain the only literature available pertaining to intraverbal responding by children who use SGDs. The current study expands this concept across children with different developmental disabilities, different types of SGD and access methods, and did not limit each child to a fixed response. This study provides preliminary evidence that children who use SGDs

can provide varied responses following model prompting by a parent and can successfully learn to answer intraverbal questions with decreasing supports from their parent.

Lastly, this study adds to the growing body of evidence supporting telepractice as an effective service-delivery model for families of children with disabilities (Tomlinson et al., 2018; Unholz- Bowden et al., 2020). None of the three participating dyads experienced significant connectivity challenges or technology barriers that impacted their participation in the study. All three parent interventionists reported that sessions were easy to fit into their routines, did not disrupt or decrease their family quality of life, and they would recommend similar studies to others. Each family was already accessing school and related services through telepractice and considered the current study as a supplemental session aimed at increasing their child's social communication skills. A limitation of the current study is there is currently no comparison to in-person service delivery of this or a similar intervention. Future research into in-person parent training on systematic prompting to increase accurate responding by children who use SGDs to answer in-person social intraverbal questions is an area of need in AAC research.

This study contributes to the growing body of research supporting the use of time delay to teach children who use SGDs to accurately respond to intraverbal questions. Lorah and colleagues reviewed four studies investigating the acquisition of intraverbal mand responses in which participants responded to requests by researchers to "Let me know what you want" using an SGD with only applicable answer choices available. These studies all used a time delay (e.g. 10 s time delay), which Lorah and colleagues shortened to 5 s to investigate the efficacy of a shorter time delay paired with physical

prompts (2015). The current study investigated the effects of a progressive time delay in which the first practice trial with the parent provided an immediate prompt followed by a 3 s time delay to provide each child with an opportunity to respond independently. During the researcher probe, the parent used a 3 s time delay to provide each child an opportunity for independent responding. This study provides preliminary evidence that a shorter time delay than previously investigated can also be effective for increasing accuracy of answering intraverbal questions by children who use SGDs.

This study also contributes to the literature on interventions aimed at increasing communication skills other than requesting and labeling by children who use SGDs. In the last 20 years of aided AAC research, most published literature increased requesting and labeling communication skills by children who use AAC (Crowe et al., 2021). The current study contributes preliminary evidence supporting the use of parent-mediated most to least prompting procedures and progressive time delay to teach intraverbal communication skills and supports the use of distance technology to increase communication skills by children who use AAC. All three children demonstrated an understanding that the researcher, while not present in their home, was a communication partner, and responded to comments and questions posed by the researcher over Zoom. Diane of Dyad 3 stated that the biggest positive gain from participating in this study was James's development of an understanding that video calls were with other people he could talk to. She explained that prior to participating in sessions with the researcher, he did not respond to communication partners on video calls and did not respond to prompts from his parents to wave, greet, or otherwise look at the video call screen. She surmised that he thought it was a television show or movie, not an interactive form of

communicating with family. She said that during the maintenance phase of the study, he brought her his SGD and gestured toward the mobile tablet they used to connect to Zoom and expressed “I want to talk”, which she understood to mean he wanted to video call and talk to someone.

The current study extends the literature with embedded target questions within the context of a social video call between the researcher and each child, aiming for a naturally occurring context with questions that a natural communication partner would ask. Previous literature, specifically the investigation by Lorah and colleagues, conducted their investigation in a clinical setting. Lorah and colleagues asked questions on a trial-by-trial basis with verbal acknowledgement by the researcher as the reinforcement for the participant responding correctly to a question (2015). Carnett and Ingvarsson conducted their investigation in a separate room in the child’s school with only two researchers as interventionists and communication partners (2016). The current study adds to the literature by conducting all aspects of the intervention within the natural environment of the participating family: All assessments, sessions, and training occurred over Zoom. This intervention was conducted in a clinical setting on a trial-by-trial basis with verbal acknowledgement by the researcher as the reinforcement for the participant responding correctly to a question.

The current study also contributes to the research on increasing intraverbal communication skills by children who use SGDs using systematic prompting. The previous studies investigating intraverbal communication skills utilized time delay: Lorah and colleagues used a 10 s time delay (2015) and Carnett and Ingvarsson used a progressive time delay from 0 s to 5 s (2016). No systematic fading of prompts was used

in either study: Physical prompting (Lorah et al., 2015) and a paired vocal and written prompt (Carnett & Ingvarsson, 2016) were used. Although independent responding during the researcher probe was not the ultimate goal of the current study, decreasing the intrusiveness of prompting throughout intervention and providing multiple opportunities for independent responding were important aims. These intervention procedures were selected to reduce the amount and level of prompts that would have to be faded and provide more opportunities for response variability.

This study utilized parent-mediated intervention: not only was a natural change agent trained to high fidelity on intervention steps, but after the study ended, that interventionist remained in the child's life as a trained communication partner. The use of most-to-least and progressive time delay prompting strategies can be generalized by the parent across communication skills and other developmental domains, increasing effective application of the principles of applied behavior analysis to improving each child's quality of life over time and across settings. The ability of each parent to generalize skill use across other routines and target vocabulary remains an empirical question. Past research with parent-mediated intervention suggests that parent training can result in generalization of skills across other domains and even other children (Radley et al., 2014). Nevertheless, selecting a natural change agent was deliberate to reduce the vacuum left after a researcher completes a study and withdraws from the child's life. Ensuring that a lifelong natural interventionist knew, understood, and mastered prompting and progressive time delay skills that might be used across skills, over time, and even with other children, improves the social and ecological validity of the current study.

This study extends research on increasing communication by children who use AAC by teaching children to answer social questions. Past research in AAC focuses on teaching children with CCN to request preferred items or activities and has not addressed the full range of social function of language or reciprocal social communication (Crowe et al., 2021). In the present study, each child was prompted with a variety of different answers, building in response flexibility from the start of intervention and increasing generalization of each question to other communication partners and across the lifespan. Each parent chose questions that could be answered using multiple responses by the child using their SGD and answers differing from parent models were immediately followed by parent delivery of high quality praise and enthusiasm to reinforce variable responding. Although not a specific dependent variable, increasing response variability within the parameters of each question was a desired outcome of this study and each question was selected for its relative open-endedness. Even the single yes/no question, "Do you like holidays?", asked of Max in Dyad 1, had a wide variety of answers. His choice was "No, I don't like holidays", but he had available many answers in his SGD's vocabulary and through model prompting from his mother, Anne. Anne modeled, "Yes, I like Thanksgiving/Christmas/my birthday" on Max's SGD and vocally spoke a variety of responses. She did this to show Max that there was not a single correct answer to the question. This study provides preliminary non-experimental evidence that collaboration with stakeholders and natural change agents to develop individualized intervention targets leads to successful increases in adult and child skills as well as increases buy-in and motivation to complete the entire project. All three parents worked with the researcher to select target questions and each level of the prompt hierarchy: This

involvement in development may have increased each parent's views of the study procedures' validity.

Each child demonstrated response variability throughout sessions; however, Max and James often re-created their mothers' model response on their SGD or spoken verbal responses to the questions. Hannah demonstrated high levels of response variability, possibly due to her not having a model prompt from Kevin and also because she was free to choose any response within a requested page. For example, when asked "What do you want to play", she was prompted to navigate to the vocabulary category pages *Want* and *Play* in sequence, but was allowed to select any response within *Play*. Within each category, Hannah had 7-15 options available; every page she navigated held 8 slots for vocabulary, one of which was always *Beginning* to return to the home screen of her device. James also demonstrated high response variability: his mother, Diane, modeled on his SGD and prompted with speech different answers to each question during sessions. The type of prompt changed based on James's progress through the intervention on researcher probes, progressing from his parent modeling a response on his SGD to his mother saying a response out loud to him. She modeled her own answers to each question during model prompting sessions but preceded each model with his SGD by saying to him "You could say…" during error correction. Each parent expressed response variability as an important value when developing the questions and did not want to target questions with fixed, rote answers. Incorporating each parents' values and goals for each of their children potentially also increased buy-in and contributed to high levels of attendance and completion of sessions.

Generalization Probes

Generalization probes did not occur as frequently as programmed, primarily due to changes in Dyad 2's school schedule. Another reason that generalization probes did not occur as planned for Dyad 2 is that Hannah already participated in a weekly video call with her grandmother. Disrupting their usual routine, during which Kevin did not directly participate in their conversation, may contribute to why generalization probes occurred less often. Dyads 1 and 3 used a researcher-created Zoom link, requiring the researcher to be present during each generalization probe. This may have resulted in more consistent probes due to scheduling all participants in advance and having the sole focus of the call be the target questions. Future research into programming additional generalization probes during each phase of intervention is warranted, including whether more involvement by the research team facilitates or impedes scheduling by participants. Another area of future research is whether more generalization probes has a positive impact on child skill acquisition, possibly due to increasing the number of trials, training across people, or increasing motivation by having the child speak with a natural communication partner.

Acceptability of the Intervention

Social validity results from the modified TARF-R questionnaire indicated that parents found the intervention procedures acceptable, intervention outcomes acceptable and helpful, and plan to apply prompting hierarchies and wait time with other child communication targets. Parents also reflected that the flexibility of scheduling and changing sessions was the most helpful aspect of conducting the study over Zoom and this greatly influenced their saying they would recommend this study to others. Another very positive outcome of participating in the study was each parent learned that their

child learned how to increase reciprocal communication over Zoom, seemed more comfortable and relaxed while interacting over Zoom, and that these communication skills are applicable with other people, during educational online sessions, and during in-person interactions.

Future research should examine the criticism raised by Kevin of Dyad 2 regarding the standardized assessments that were conducted during pre-baseline. He found the assessments, particularly the Vineland-3, to be a negative experience that almost resulted in his leaving the study. Responding to items asking about skills that children with severe disabilities likely do not demonstrate was very aversive to him. The Vineland-3 was selected by the research team for its being a normed assessment that provided standard scores recognizable by a wide range of readers and for reporting out present levels of participants in the relevant domains of Socialization and Communication skills. Future researchers should determine whether standardized assessments are necessary for reporting out present levels of study participants and whether more specific instruments intended for use with children with CCN can instead be used.

This research extends the literature on AAC interventions for children who use AAC, which has primarily focused on requests and labels despite calls for increased research on social and reciprocal communication skills (Crowe et al., 2021). Teaching functional communication skills to children who use AAC is necessary and important (Mirenda, 2003), especially for individuals who exhibit challenging behavior related to meeting their needs; however, social closeness, friendship, and family connection are also crucial aspects of a child's life and happiness. Children with disabilities, especially children who use AAC, experience social isolation due to difficulties interacting with

peers and have fewer opportunities to communicate with others (Chung et al., 2012). Children who use AAC also have greater difficulties communicating over technology: reciprocal conversation skills are often not the focus of school or clinic-based communication intervention (Crowe et al., 2021). Opportunities to communicate with family and friends became even more limited during the Covid-19 pandemic; children with disabilities who are at high risk of serious illness and complications became even more socially isolated due to withdrawal from in-person schooling and lack of accessibility of virtual learning (Villano, 2020). Combining telepractice/telebehavioral interventions with parent training may reduce barriers to learning faced by children with disabilities, help parents feel empowered and equipped with skills to teach their children, and increase socially valid communication skills for children who use SGDs.

Parent responses during the social validity debrief session reflect the challenges of engaging in single-case research studies within the context of family life for children with disabilities. Both Anne and Diane indicated that their sons were agitated and frustrated during baseline sessions because their sons did not know the answers, didn't know what was being asked of them, and their mothers were not providing any support. In a natural setting, determining or probing baseline performance wouldn't be required to last 8 or 11 consecutive sessions before teaching began. Although parents were informed before starting that there would be a set number of baseline sessions prior to parent training, experiencing and observing their child's frustration during a large number of baseline sessions was the most difficult and challenging part of participation in this study for Anne and Diane. Multiple-probe designs may be more suitable for experimental interventions with this population.

This intervention focused on parent training for multiple reasons, including training a natural and long-term communication partner of each child, increasing validity during video calls by having a natural interventionist provide prompts during conversation, and increasing the skills of a trained communication partner. Barriers to using AAC include high demands of the communication partner's knowledge and skills related to use and maintenance of the actual device as well as wait time, prompting, and communication breakdowns (Caron et al., 2015; Holyfield et al., 2017). While this project did not directly address communication breakdowns and repair between child and video caller, parent training on error correction did occur and parents reported feeling more confident about stepping in when their child made an error. Parents also reported they felt the parent training was the most helpful part of participation and that they would use the prompting strategies across other communication skills and developmental domains. Parents also expressed appreciation for the use of progressive time delay, reporting that having to consistently provide wait time for their child increased parent awareness of their child's skills to independently respond.

Limitations and Recommendations for Future Research

One limitation of the current research is the absence of assessment of parent knowledge and prior experience with behavioral principles and systematic prompting procedures before and after this intervention. Parents may have learned the prompting hierarchy and strategies related to the target questions and not the behavioral principles that underlie the intervention procedures. Parents were encouraged during the didactic instruction of parent training and during the debrief session to apply prompting strategies and moving from more support to less support to other social questions, communication

skills, and behavioral domains but were not provided specific examples or instruction on how to do so.

Efficacy of the didactic instruction videos and BST on parent knowledge and skill acquisition is not known, nor whether the training videos were effective compared to BST alone. During the debrief session during which each parent completed social validity information, each parent expressed positive experiences with learning the intervention procedures and stated they see the potential for using most-to-least prompting and progressive time delay for other purposes; however, none of the three parents stated that they had tried the prompting procedures with other skills.

Future studies could extend maintenance sessions and check in with the parents after longer intervals than 1 month post-intervention to determine whether parental skills generalized across skills and maintained with high fidelity over time. The current study planned for conducting generalization probes at least twice per baseline and intervention phases; this occurred for two dyads but did not occur for another dyad. One reason for Dyad 2's difficulty in conducting generalization probes could be that Hannah already had weekly video calls with her grandmother, during which grandma's asking specific target questions was not routine. Kevin, Hannah's father, expressed that he set up the technology for Hannah and her grandmother, then left them to independently interact. The added effort of changing Kevin's routine around setting up the call and adding a specific task to grandma's conversation may be why so few generalization probes occurred. The other two dyads scheduled Zoom calls with the third caller and the researcher, ensuring that all parties were available and prepared for the generalization probe and putting the effort of recording the conversation on the researcher. Future

research could investigate whether random assignment of sessions as generalization probes, randomly assigning the number of generalization probes conducted per phase, and whether putting generalization probe scheduling responsibility on the researcher alone leads to greater success with programming for generalization. Another area for future research is conducting indirect check-ins to probe generalization and maintenance of skills via online survey or text message. Using different technological communication methods could reduce the amount of time and effort demanded of researchers and participants. Future research into additional technological solutions to generalization probe data collection is an area of need in AAC research.

Another limitation related to parent implementation is the researcher's virtual presence during all intervention sessions. Due to the technology constraints of parents' home hardware, the researcher was also present during all generalization probes for Dyads 1 and 3, potentially impacting the non-parent interventionist and parent performance during the call. The researcher blanked out her screen and was silent during the call, but observer effects may have still occurred. Future research could explore additional technological solutions for recording generalization probes without the researcher's presence over Zoom. Another avenue for future research is recording parent-child sessions without the researcher present as a generalization probe for parent use of strategies without the option of researcher coaching. Knowing that the researcher was present and watching, especially taking data on parent behavior, may have influenced parents' performance during sessions that will not maintain once Zoom sessions ceased.

Parent satisfaction with the intervention procedures was overall high. Anne expressed more concerns about the intervention procedures: Max demonstrated

independent responding much sooner than the other two children and his mother, Anne, stated that he may have become bored with being asked the same questions time after time. Kevin, of Dyad 2, reported that determining the prompting levels was widely helpful for assisting Hannah's school and private education service providers. He also stated that while they had not participated in a study that specifically targeted a skill as this study did, they found it an overall positive experience and it was rewarding to see significant progress with this targeted skill. Diane, of Dyad 3, reported that adding anything new to their schedule and routine took some adjustment, including her request that the researcher text her 15 min before each session which was much appreciated and very helpful. Diane also reported that because she had been working with James's communication since he was 1 year old, this study did not increase her knowledge or skills related to prompting, wait time, or showing James how to respond using his SGD. Her most significant positive outcome was observing James look at, respond to, and ask questions of a person on a video call, which had never occurred before this study.

Response bias during social validity measures could also be related to the researcher's presence during the semi-structured interviewers and serving as the interviewer. While the current study used a more objective measure of social validity, the modified TARF-R, the researcher conducted all of the semi-structured interviews with each parent, possibly leading to the parents changing their responses (Barton et al., 2018; D'Agostino et al., 2019). Assessing social and ecological validity remains an area of need within intervention research and while this study moves the field forward by attempting to include child participant social validity assessment, bias in parent responses was

probable. Future research should utilize an unfamiliar interviewer for social validity assessment with participants to reduce or eliminate potential response bias.

This study was designed for children with significant support needs whose rate of learning precluded independent responding during a single study lasting 4 months. Future research on differentiating interventions for children with fast acquisition rates is needed. One solution is to structure the intervention to permit adding target questions and comments after mastery criterion is met for independent responding. Another target for future AAC research is teaching children who use SGDs to ask reciprocal questions as conversational turns, such as asking *How are you?* after answering that question asked by their communication partner.

Future research related to the social validity of telepractice could compare efficacy and stakeholder satisfaction of in-person versus telepractice parent training on increasing child use of their SGD in social contexts. While this study included the use of social validity questionnaires as well as a brief semi-structured interview with each parent, conducting multiple interviews with parents to gather thick data about parent experiences, concerns, and opinions about telepractice interventions is an area for future research.

Another area of need related to the social validity of AAC research is investigating family and stakeholder perceptions of the SGD, how it is integrated into their lives and routines, and acceptability of the device. Conducting a pre-intervention interview to gather data related to parent views of their child's SGD, previous experiences with training and interventions related to the SGD, and parent perceptions around the SGD would yield fascinating information about the changes that SGDs have

on family life. Another topic of interest would be comparing parent pre-intervention perceptions of the study target, increasing child participation during social conversation, to parent perceptions after intervention has completed. Analyzing parent data for changes, highlighting parent concerns that were not addressed by the current study, and continuing to center parent participation in intervention development are all needed areas for future research.

The heterogeneity of the child participants of this study is both an area of strength and a potential limitation. Each child was eligible for special education services under different disability categories, two of the children used touchscreen mobile tablets as their SGD and both were able to complete four target questions during each session. Hannah, who differed from the boys not only in gender identity but also in complexity of support needs and her use of alternate access, required a more highly modified intervention including decreased target questions, and discontinuous data collection due to medical needs. The heterogeneity of the participants is on one hand a strength of this study, demonstrating that parent-implemented prompting procedures are effective at increasing accurate responding for individuals with IDD. It is also a limitation: Further replication across participants with these and other disabilities and support needs is warranted before claims can be made of efficacy for children with CCN who also have ASD, other health impairments impacting mobility, vision, and general health, and neurogenetic conditions.

Replication across the age groups of each participant is also an area of further research: Max and James were adolescents while Hannah was an older elementary school-aged child. Each participant was in a different grade and, had school been in session, would have been in elementary, middle, and high school. Applying parent-

mediated intervention procedures with more homogenous ages of children would increase the strength of evidence that these procedures are effective for children ages 8-15 years. In addition to replicating these results with older elementary and adolescent children, expanding age inclusion to younger and older individuals is also warranted. Investigating whether parent-training via telepractice can effectively increase social communication skills of young children with disabilities remains an area of need for early intervention AAC research. Likewise, including adults with complex communication needs is an area of need in aided AAC research (Crowe et al., 2021).

An area of strength of the current study was parent participation to the greatest extent possible in the individualization of the intervention for their child. Target questions were selected primarily by parents whose main consideration was what types of questions family members ask on social video calls. Due to the flexibility of individualizing the questions and allowing each child some latitude in how each question is answered increased contextual fit and social validity of each child's targets; however, if the child was on a social call with a friend or classmate, different questions and likely different response would be warranted. Replicating these procedures with peers as the communication partners each participant speaks with over video calls would increase the social validity of this intervention. The current study targeted family members as the primary video call audience; due to the Covid-19 pandemic restricting travel and in-person visits, this was chosen as an area of immediate need for children with disabilities and CCN who participate on Zoom calls with students and teachers but may not have a learning history of reciprocal communication over video calls with family members. Training peers to be effective tele-communication partners of individuals who use SGDs

remains an area of need as does research on increasing reciprocal communication during peer interactions by individuals who use SGDs.

Although the current study incorporated parent input in developing target questions and prompting hierarchies, a limitation of this study was the lack of family-centered planning and inclusion of the child participant in development of the questions and the prompting procedures. Contextual fit was established with the parent interventionist's coming up with the target questions, which in the case of Dyad 1 needed to be changed from "What is your favorite holiday?" to "Do you like holidays?" based on Max's agitated behavior when asked this question. Kevin (father in Dyad 2) was actively involved in determining which target questions to ask, how difficult each answer would be for Hannah to navigate to, and what prompts would be most effective in ensuring the most errorless learning process for his daughter. Despite the close collaboration between researcher and interventionist parent, future research should provide each child with an opportunity to provide input on development and selection of targets and procedures. Adolescents especially should be given the opportunity to integrate their preferences and priorities as well as input sought on what questions and topics their peers are discussing (Smith, 2015). This intervention was aimed at increasing independent participation on family video calls during a pandemic; facilitating peer, sibling, and schoolmate conversation are future areas of investigation.

This study is the first to combine telepractice parent training with children who use SGDs to increase social communication skills. Future research including replication across disabilities, support needs, and ages is warranted to extend the implications of this study and expand the applications of these procedures. Training natural change agents to

be effective communication partners as well as effective interventionists doesn't end at parent training. Training and coaching siblings, other family members, teachers, clinicians in outpatient clinics, peers at school, and community members who regularly interact with the child who uses AAC are all crucial for communication skill acquisition and maintenance (Chung et al., 2012; Light et al., 2019). Telepractice can reduce barriers to child and family access to skilled researchers and coaches, increase collaboration among related service providers for children, and facilitate long-term interventions to increase social communication for children who use AAC.

This study excluded children who use eye gaze to activate their SGD due to expected challenges with prompting. Physical prompting was not used with any of the three children but was considered a necessary requirement if a child did not respond consistently to model prompting. Prompting eye gaze is very different from prompting a body part movement: physical prompting is not possible, model prompting is unlikely to elicit a response, and eye gaze technology remains imperfect and sometimes inaccurate (Feit et al., 2017; Gibaldi et al., 2017). A literature search of two large electronic research databases yields no results for the keywords "eye gaze" OR "eye tracking" AND "speech generating device" AND "prompt*" and there are no literature review results for a search of "eye gaze OR eye tracking" AND "speech generating device." Future research on how to effectively prompt children who use eye gaze to access their SGDs is needed, especially as technology improves and eye gaze technology is more accurate and responsive. Additionally, a review of research literature investigating eye tracking technology and speech generating devices is needed, both for individuals with IDD and

for individuals with complex communication needs due to conditions such as stroke, traumatic brain injury, or amyotrophic lateral sclerosis.

While research supports the use of parents as interventionists who implement procedures with high treatment fidelity, less research involves sibling or peer mediated interventions for children who use AAC. Training and coaching other children to ask questions, wait for a response before prompting, and encouraging the child who uses AAC to also ask questions are all areas of future research that are sorely needed. Research into interventions to increase reciprocal conversation and train similar-aged peers are next steps for researchers to explore. The use of BST for training and coaching parents, caregivers, and educators is well established in the research literature (Miltenberger, 2011; Rosales et al., 2009) but reciprocal conversation and communicative functions other than requesting and labeling remain unexplored. Researching peer-mediated interventions to increase social communication skills of individuals who use AAC can also explore definitions of and changes in social closeness between peers and children who use AAC. Students who use AAC report having friendships at school but are not perceived as playmates or identified as friends by peer students without disabilities, indicating that relationships between individuals with disabilities and peers are not reciprocal (Østvik et al., 2018). Peer-mediated intervention is an evidence-based practice for increasing social skills and learning outcomes for students with intellectual disabilities (Schaefer et al., 2016). To date, there is a single study exploring peer-mediated interventions with individuals who use AAC with disabilities other than ASD. This complex single case research design implemented a peer-mediated intervention to teach peers to stay, play, and communicate with target students with Down syndrome

who used high tech SGDs (Severini et al., 2019). This study included a training session in which the peer was taught how to use the SGD by researcher-mediated modeling and prompting use of the device; however, some of the target children who used AAC were not familiar with nor skilled at using their SGDs independently which may have impeded evaluation of the peer mediated intervention (Severini et al., 2019).

Research on the effects of changing and increasing access to vocabulary on their SGD is another area of need. Selecting AAC vocabulary that is socially relevant to the user could also increase treatment adherence and maintenance of communication skills. AAC vocabulary is often selected by adults, particularly parents and professionals (Trembath et al., 2007), who carefully curate frequently used or socially appropriate vocabulary for the AAC user, potentially without considering actual phrases commonly used by the individual who uses AAC's peers. Conducting observations of the AAC user's same age peers and collecting language samples in a variety of contexts and with a variety of conversation partners (teachers, parents, friends) would yield more ecologically valid communication targets and vocabulary (Schwartz & Baer, 1991).

Incorporating socially valid but not necessarily school appropriate vocabulary (Ashby et al., 2015), e.g. potty themed jokes for a kindergartner, dating and sex for a high schooler, or alcoholic beverages for an adult, is often ignored by parents and professionals who may find discussion of these topics difficult and uncomfortable, but these are topics the user may want to access to increase social interactions with peers (Bryen, 2008; Smith, 2015). The intervention sessions that James answered half the questions correctly occurred after he had multiple new icons added to his talker. These were very specific vocabulary items requested by his family such as "Bible stories",

"play on the swings", and "my puppies". His interest in activating these responses, specifically "Bible stories", interfered with his responding to the target questions and Diane's prompts and encouragement to answer the questions. Social validity of AAC vocabulary is an under-researched area, especially for adolescents and adults (Bryen, 2008; Smith, 2015).

One of the challenges with using SGDs is communication breakdowns, in which messaging is unintelligible, not understood by the listener, or incomplete. Communication breakdown can also be defined as a communication act not immediately resulting in the desired consequence (Halle et al., 2004). Communication partners may use repair strategies such as asking for repetition, clarification (Barstein et al., 2018), or using backup communication systems such as gestures or visuals to facilitate successful repair. Research suggests that individuals with IDD benefit from interventions aimed at teaching repair strategies: picture cards were used to teach an individual with autism to identify and repair communication breakdowns (Ohtake et al., 2010). Regarding communication with peers, individuals with severe disabilities who exhibited natural speech successfully increased use of repaired messaged when trained peers asked for communication repair (Weiner, 2005).

The impact of motivating operations on behavior to repair communication breakdowns may affect how perseverative the communication partner is to identify the breakdown and responses by the person who uses AAC to persist in attempting to repair communication (Halle, et al., 2004). A request for a highly motivating item, such as a spoon when given a bowl of ice cream, may have a very different value than a request for personal information, such as stating a favored color. Another effect of motivating

operations for communication repair is the reinforcing value of the communication partner: if there is a history of highly motivating activities and high engagement, the person who uses AAC may persist in attempting communication repair. Estimates of how often individuals with IDD experience communication breakdowns vary from 40% of initiations resulting in communication breakdown to over 60% of communication acts being unsuccessful by young children (Wetherby et al., 1998). In an analysis of communication breakdowns between students who use AAC and school staff, Hetzroni and Shalev found that 57% of total communication behaviors were communication breakdowns and the most frequent repair strategy used was repeating the message (2017). Studies teaching individuals with developmental disabilities to use AAC as a repair strategy for communication breakdowns involving gestures have demonstrated the use of AAC as an effective repair strategy (Ohtake et al., 2010; Sigafoos et al., 2004). Communication breakdown identification and repair strategies of individuals with IDD who use SGDs is an area of need in the research literature, as is intervention strategies to teach individuals who use SGDs to use backup strategies if their AAC system is unavailable.

Programming for generalization has been an issue in single case research for decades and is discussed at length in a seminal paper published in 1977 by Stokes and Baer. Their recommendation to behavioral researchers is to program specifically for generalization rather than rely on "train and hope," a recommendation that was incorporated into the current study. The current study programmed for generalization by using a natural environment for instruction, training a natural interventionist, and providing multiple opportunities for each child to practice communication over video

calls with different people. These are all recommendations for increasing generalization of communication skills by children with disabilities who use AAC (Calculator, 1988). While generalization probes were planned for during each phase of the study other than parent training sessions, they occurred far less often. Family scheduling, winter break, and bouts of illness impacted each dyad's ability to schedule and follow through with generalization probes when recommended by the researcher. Diane and James in Dyad 3 took 2 weeks off during baseline to travel out of state for a family wedding and holiday visit. Hannah of Dyad 2 had multiple weeks where she and Kevin attended a single session due to medical appointments or not feeling well. These interruptions impacted generalization probes, which could not take place when the child was unavailable. Future research should emphasize frequent programming for generalization across all phases of intervention, ensuring that parents know and understand the purpose and importance of scheduling generalization probes.

Children who emit vocal speech hear thousands of spoken words before developing and utilizing natural speech: Children who use AAC have much fewer opportunities for receptive language input using their communication system (Calculator, 1999). Children who use AAC have fewer opportunities for AAC language input, fewer opportunities to practice communication skills, and contact reinforcement less often due to the physical constraints of their AAC systems and having fewer skilled communication partners (Calculator, 1999; Carter & Maxwell, 1998; Sigafoos, 1999). Teaching children with IDD who use AAC to use their SGD across communication partners, settings, and activities requires multiple opportunities to provide input, model syntax, and prompt responding (Kent-Walsh & McNaughton, 2005). Partner augmented input (PAI), also

referred to as communication partner modeling, natural aided language, aided language modeling, and aided language stimulation, involves the communication partner also using the AAC system while communicating using vocal verbal speech (Senner & Baud, 2017). PAI interventions have successfully trained group home staff (McNaughton & Light, 1989), elementary school aged classmates (Carter & Maxwell, 1998), and school-based educational staff (Senner & Baud, 2017) and increased communication opportunities (Iacono et al., 1998), turn-taking skills, and types of communication functions (Light et al., 1992).

PAI shows promise as a naturalistic communication intervention with positive outcomes for the AAC user in the areas of increased turn taking, increased vocabulary knowledge, and more complex communication utterances (Shire & Jones, 2015). Most research on modeling and its impact on AAC use has been conducted on preschool-aged children with disabilities other than ASD (Sennott et al., 2016), and very little on older participants or individuals with other conditions, including severe disabilities. Future research on using PAI with natural change agents such as parents, siblings, and peers, is an area of need for increasing the number of trained communication partners available to children who use AAC.

Research involving participants with significant challenging behavior, particularly individuals whose aggression and/or self-injurious behavior is a serious ethical concern, remains a need within AAC literature (Smidt et al., 2007; Tager-Flusberg et al., 2017). Individuals with CCN may use a variety of behaviors that are inappropriate or harmful and thus considered challenging behavior; these may also be viewed as communicative acts (Bopp et al., 2004). The present study excluded children whose challenging

behaviors were potentially unsafe for their participation due to the intensive nature of parental involvement. Telepractice technology has been used to train and coach parents on implementation of functional assessments to determine the function(s) of challenging behavior (Machalicek et al., 2016; Suess et al., 2014; Wacker et al., 2013). Determining the function(s) of challenging behavior examines motivation operations, antecedents, behavior, and consequences to hypothesize why the challenging behavior occurs and under what circumstances (Cooper et al., 2007). Telepractice-delivered interventions have also been used to train and coach parents on functional communication training to replace challenging behavior (e.g. Wacker et al., 2013), this remains an ethical concern for researchers and clinicians. Putting parents in harm's way, setting up conditions in which challenging behavior may be evoked, especially during baseline conditions, and targeting brand-new and complex behaviors such as answering intraverbal questions that have no point-to-point correspondence were all considerations for the researcher's exclusion of children with significant challenging behavior. Future research is needed on how to address safety during telepractice sessions, including incorporating functional behavior assessments and behavior safety plans into telepractice communication intervention sessions.

This study planned for the as needed use of noncontingent reinforcement for appropriate learning behaviors during sessions, such as staying seated near the child's SGD, responding to prompts, and using the SGD to respond to questions. None of the parents needed to praise their child for staying seated near their SGD or for exhibiting active listening behaviors; however, the three children did not exhibit challenging behaviors that impeded their participation in sessions. The use of extrinsic rewards, such

as token economy boards or tangible rewards for responding or completing a session, were not used by any of the included dyads; future research with participants who exhibit mild to moderate challenging behaviors such as leaving the session area, not responding to prompts, or turning away from the SGD is warranted and needed. Additional research on the impact of extrinsic rewards for social communication behaviors may also be warranted, especially for children with challenging behavior.

Assessing pre- and post-intervention communication skills changes in each child was another limitation of the current study. While two domains of the Vineland-3 were administered via parent interview prior to beginning baseline sessions, the Vineland-3 Communication domain did not have items specific to the skills targeted by the Teleconnecting intervention. Additionally, answering two to four intraverbal questions would not have increased child scores on the VBMAPP intraverbal section. Results of the intervention, though providing strong preliminary evidence that children with disabilities who use SGDs can acquire variable and accurate responding to social intraverbals on video calls, were not significant enough to change child scores on either instrument. Selection of more sensitive instruments or expanding the number of intraverbals targeted by an intervention are both areas that future research can explore regarding increasing child scores on communication assessments.

Additionally, this research may be limited in its external validity due to the homogeneity of the participants' demographic information. While each participant had a different disability diagnosis with varying impacts on their learning and support needs, all three dyads were White, English-speaking, from nuclear families of two parents and siblings, and from a single geographical region of the United States. Another limitation

related to the demographics of the participants relates to their education and income levels. Each participating parent completed a researcher-created online survey about their demographics: all three participating parents were college graduates and reported having "just enough money for our family's needs."

All three families were located within the Pacific Northwest and lived at most 120 miles away from the researcher's university, although none of them utilized the university for clinical or educational support services. The researcher placed no geographic or location limitations during recruitment other than within the United States. Recruitment materials were shared nationally on social media and via direct email; however, only these three parents responded with interest. Future research is needed for replication of these intervention procedures with families living in rural and underresourced areas, multicultural and multilingual families, and families living in other areas and regions of the world.

Recruitment and retention of diverse participants utilizing intentional sampling methods remain an issue within special education and AAC research. There were primary language restrictions placed on eligibility due to the limitations of the single researcher's monolingualism. Future research should explore the use of telepractice for delivering intervention to multilingual families; telepractice can effectively reduce barriers to families living in areas where service providers do not identify with their cultures or fluently speak their languages (Boisvert et al., 2010; Ghaddar et al., 2020). Avenues for future research include training and coaching non-parent caregivers such as grandparents or older siblings, providing training and coaching in English as well as the family's heritage language, and teaching children who use SGDs to respond in more than one

language by language matching to their communication partner. Future research utilizing language interpreters and translated materials to provide culturally adapted and linguistically valid interventions to diverse families remains an area of need in AAC literature (Soto & Yu, 2014).

Conclusion

This study evaluated the effects of telepractice coaching on parent implemented use of prompting strategies to teach their child to accurately answer social intraverbal questions with their speech generating device on video calls. A multiple baseline single case experimental design across dyads was used to evaluate parent use of strategies and child accurate responding. Visual analysis and Tau-U were used to evaluate within-case effects and a functional relation was established for all three parents and all three children. The between case standardized mean calculations support a very large effect for parent use of strategies and child responding. This study provides preliminary evidence that researcher mediated telepractice behavior skills parent training is effective in increasing parent use of strategies and those results maintain over intervention sessions.

This study also provides preliminary evidence that parent use of systematic prompting procedures is effective in increasing child accurate answering of social intraverbal questions with a speech generating device. The intervention procedures, including scheduling and completing all phases of the study, were viewed as helpful, leading to gains in their child's skills, and not disruptive or uncomfortable by all three participating parents. This study addresses the research gaps of telepractice parent training on communication interventions for children who use augmentative and

alternative communication and behavioral interventions to increase social communication on video calls by children who use speech generating devices.

APPENDIX A
INTERVENTION MATERIALS

Script for parent training

Becky Say	Becky Do	Parent Say	Parent Do
Before starting Zoom call:	Materials: Checklist Parent fidelity data sheet SGD or mockup Cold probe data sheet		
Hi! How are you today? Great! First let's make sure that you have everything you need: Your quick checklist The AAC device Something to write with Prize/reward for your child	Check off materials	Check-in	Show materials to Becky
Awesome! The first thing we want to do is check the device: make sure it turns on, the volume is loud enough to hear Perfect!	Demo with SGD		Turns on AAC Activates an icon
Now let's check the questions: can you show me the	Have emailed/texted		Write

Becky Say	Becky Do	Parent Say	Parent Do
checklist just so I can double check we have the same order for today? Go ahead and write them down on your checklist. You can write the whole question or short notes, as long as you know which question is which	questions at least 2 hours before session start		question or hint on checklist
Perfect! Next you're going to write down what level of prompting you're using for each question. So for question 1, you're using hand over hand and for questions 2, 3, 4 you're using point to the icon. Go ahead and write those in the checklist			Write level of prompting for each question in checklist
Awesome! Let's double check that the answer choices on the device are set up and ready to go. Go ahead and press each choice.			Programs or puts the corresponding responses on the device
And then we're going to check to make sure the right answers are recorded on there for each answer choice. I'm here if you need any help recording			Parent activates each icon to check recorded message
Great! Before we get [child] and get going, Do you have		Expresses	

Becky Say	Becky Do	Parent Say	Parent Do
any questions about today's session? Remember to keep [child]'s prize in sight but out of their reach until the end of the session and to start your interval timer. When the timer goes off, either praise or hug/squeeze [child]: we want our session to be fun and to reward [child] for all their hard work! Do you have any questions about today's session?		concerns/questions Has none	
After addressing questions or concerns: For BST: Today we're practicing the session without [child]. Instead, we'll pretend [child] is here. At least once during BST: Today we're going to practice what to do if [child] answers the question wrong during the 3 sec wait. Let's do it for the first question and I'm here to coach you through it if you need For actual session: Great! We're ready for [child] and to start the session! Remember, I'm here for you if you need any coaching during the first part of the session and then I'll say hi and ask the questions at the end.			For session: Parent calls/gets child to session area

Becky Say	Becky Do	Parent Say	Parent Do
First, you're going to practice asking the questions and prompting [child] through answering them. Go ahead and ask the first question. As soon as you're done asking the question, you're going to help [child] answer it by pushing the answer picture, which will show [child] to push the picture		Asks first question	Immediately prompts child (child responds) Praise for responding with prompt
Fantastic! Go ahead and ask the question again, this time silently counting to 3 before you give the prompt. If [child] answers while you're counting, that's amazing! Give them tons and tons of praise because that's the goal!		Asks first question Lots of praise if child independently responds Praise for responding with prompt	Prompts if no response within 3 s of asking
So good! You can take a couple seconds to hug/squeeze [child] and then when you're ready, ask the second question and immediately prompt the answer		Ask second question Praise for responding with prompt	Immediately prompts child (child responds) Praise for responding

Becky Say	Becky Do	Parent Say	Parent Do
			with prompt
Perfect! Ask the question again, counting to 3 before prompting [child] If they answer while you're counting, remember to give LOTS of praise!		Ask second question Lots of praise if child independently responds Praise for responding with prompt	Prompts if no response within 3 s of asking
Awesome! You can take a couple seconds to hug/squeeze [child] and then when you're ready, ask the third question and immediately prompt the answer		Ask third question Praise for responding with prompt	Immediately prompts child (child responds) Praise for responding with prompt
Great! Ask the question again, counting to 3 before prompting [child] If they answer while you're counting, remember to give		Ask third question Lots of praise if child independently	Prompts if no response within 3 s of asking

Becky Say	Becky Do	Parent Say	Parent Do
LOTS of praise!		responds Praise for responding with prompt	
So good! You can take a couple seconds to hug/squeeze [child] and then when you're ready, ask the last question and immediately prompt the answer		Ask fourth question Praise for responding with prompt	Immediately prompts child (child responds) Praise for responding with prompt
Perfect! Ask the question again, counting to 3 before prompting [child] If they answer while you're counting, remember to give LOTS of praise!		Ask fourth question Lots of praise if child independently responds Praise for responding with prompt	Prompts if no response within 3 s of asking
You're doing such a great job asking the questions,			Provide 1 min

Becky Say	Becky Do	Parent Say	Parent Do
remembering to prompt [child], and remembering to wait 3 seconds when you ask the second time! You both have been doing such hard work: if you need to stand up and stretch or jump before we do the next part, go ahead			break to child
Ok. Now we'll have [child] video call with me on the computer I'll ask each question and this time, [parent], you're going to wait 3 seconds every time to give [child] a chance to answer before prompting. You're going to use the same prompt for each question that you have written down. If you have any questions or need any reminders, I'm here to coach you if you need, but you've got this!	Have cold probe data sheet ready		
Hi, [child]! Thank you for coming to talk to me! (give compliment) It's so good to talk to you!			
Asks first question	Take cold probe data	Praise for listening/answering	Wait 3 s then prompt
Responds to child's answer Makes unrelated comment			
Asks second question	Take cold probe data	Praise for listening/answering	Wait 3 s then prompt

Becky Say	Becky Do	Parent Say	Parent Do
Responds to child's answer Makes unrelated comment			
Asks third question	Take cold probe data	Praise for listening/answering	Wait 3s then prompt
Responds to child's answer Makes unrelated comment			
Asks fourth question	Take cold probe data	Praise for listening/answering	Wait 3s then prompt
Responds to child's answer			
Thank you so much for talking to me today! You did such a great job! I love calling you!		Gives child reward/prize	Praises child for session Tells child "all done, go play" or similar
When child has left, debrief with parent What went well during session Parent questions/concerns Constructive feedback about any fidelity issues What went well with reinforcement, prompting Constructive feedback to refine reinforcement if needed			Provide feedback on session, issues, feelings, questions,

Becky Say	Becky Do	Parent Say	Parent Do
-I really liked how you ___ -I noticed that ____ seemed difficult: did that feel ok to you?			concerns
Check in about next session date time How are video calls with [family member(s)] going? Are you having any trouble scheduling or recording those? (generalization probes) Perfect, so our next session is X, and if you can get [child] on a call with [family member] this week, that would be fantastic! You're doing such a great job working with [child] and really responding to my feedback! Thank you so much for being such a great parent and communication partner for [child], etc.			Confirm next session, problem solve calls with other family

Parent checklist

You need	You do	You say
Checklist AAC device Today's question list	Set up the device - Icons Voice recording	
Zoom	Call Becky	Check in, questions
Question 1:	Prompt: _____ 1st ask: no prompt 2nd ask: prompt right away 3rd ask: wait 3 seconds and then prompt	Praise for: -correct responding -sitting with you -answering questions -talking with Becky -listening to the questions Wrong answer: 1. Oh! We did/You love [say the right answer] 2. Push the right answer on the device 3. We went to/you love [prompt level 3]
Question 2:	Prompt: _____ 1st ask: no prompt 2nd ask: prompt right away 3rd ask: wait 3 seconds and then prompt	
Question 3:	Prompt: _____ 1st ask: no prompt 2nd ask: prompt right away 3rd ask: wait 3 seconds and then prompt	
Question 4:	Prompt: _____ 1st ask: no prompt 2nd ask: prompt right	

	away 3rd ask: wait 3 seconds and then prompt	
Reward	Give reward & praise	

APPENDIX B

DATA COLLECTION MATERIALS

Interventionist Fidelity Checklist – Parent Training Sessions

	Session Date								
Did Becky:									
Greet parent									
- SGD									
- Checklist									
- Questions									
- Reward (?)									
- Device check									
Give prompts									
- Q1									
- Q2									
- Q3									
- Q4									
- Does parent have questions?									
Remind about NCR (?)									
Let's start									
Coach if needed:									
- Q1									
- Q2									
- Q3									
- Q4									
Greet child									
Ask Q1									
Respond									
Ask Q2									
Respond									
Ask Q3									
Respond									
Ask Q4									
Respond									
Thank child									
Tell child all done									
Check in with parent									
Feedback on session									
Confirm next session									
Generalization (?)									
Thank parent									
Farewell parent									
Number correct									
Number possible									
Percent correct									

Child data sheet:

Child Data Date: Dyad:

Date	Question	0s	3s	CP	Prompted:	Unprompted	
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

APPENDIX C
SOCIAL VALIDITY MEASURES

Modified TARF-R: Parent Interventionist

Teleconnecting Intervention
Social Validity

Please score each item by circling the number that best indicates how you feel about the play date intervention.

1. How acceptable was scheduling the sessions (parent training and child sessions)?

1	2	3	4	5
Not at all acceptable		Neutral		Very acceptable

2. How willing would you be to participate in another study similar to this?

1	2	3	4	5
Not at all willing		Neutral		Very willing

3. How likely are you to recommend this intervention to other parents?

1	2	3	4	5
Not likely		Neutral		Very likely

4. If you were recommending this study to another parent, how much time would you say is required?

1	2	3	4	5
Little time will be needed		Neutral		Much time will be needed

5. How effective do you think the intervention was on increasing your child's answering questions?

1	2	3	4	5
Not at all effective		Neutral		Very effective

6. How likely are you to continue arranging video calls with your child and other family members?

1	2	3	4	5
Unlikely		Neutral		Very likely

7. How disruptive was the intervention to your schedule/routines?

1	2	3	4	5
Not at all disruptive		Neutral		Very disruptive

8. Do you believe the intervention resulted in positive lasting changes in you?

1	2	3	4	5
Not at all		Neutral		Very much

9. How much discomfort did you or your child experience during sessions?

1	2	3	4	5
No discomfort at all		Neutral		A lot of discomfort

10. Would you identify the intervention as increasing positive interactions between you and your child?

1	2	3	4	5
Not at all		Neutral		Very much

11. Please write anything else you would like the research team to know about the study:

(Adapted from the TREATMENT ACCEPTABILITY RATING FORM—REVISED; TARF-R, Reimers & Wacker, 1988)

Modified TARF-R Non-Interventionist family members/caregivers/parents

Teleconnecting Intervention
Social Validity

Please score each item by circling the number that best indicates how you feel about the play date intervention.

1. How acceptable did you find the study procedures?

1	2	3	4	5
Not at all acceptable		Neutral		Very acceptable

2. How willing would you be to recommend this type of study to other people you know?

1	2	3	4	5
Not at all willing		Neutral		Very willing

3. How likely are you to recommend this intervention to other parents?

1	2	3	4	5
Not at all likely		Neutral		Very likely

4. If you were recommending this study to another parent, how much time would you say is required?

1	2	3	4	5
Little time will be needed		Neutral		Much time will be needed

5. How effective do you think the intervention was on increasing the child's using their device?

1	2	3	4	5
Not at all effective		Neutral		Very effective

6. Do you believe the intervention resulted in positive lasting changes in the child?

1	2	3	4	5
Not at all		Neutral		Very Much

7. Do you believe the intervention resulted in positive lasting changes in the parent?

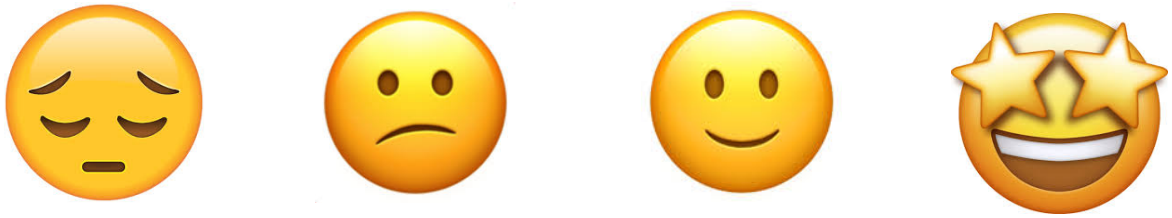
1	2	3	4	5
Not at all		Neutral		Very much

8. Please write anything else you would like the research team to know about the study:

(Adapted from the TREATMENT ACCEPTABILITY RATING FORM—REVISED; TARF-R, Reimers & Wacker, 1988)

Modified TARF-R: Child Participant

1. Did you like talking with Becky on the video call?

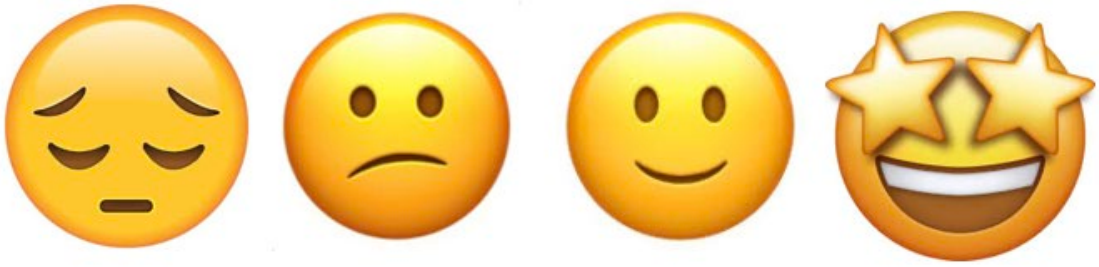


2. What was your favorite part about talking on the video calls?

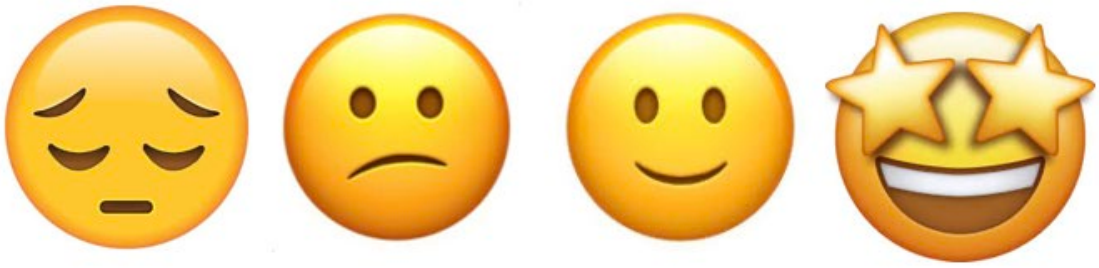
_____
_

_____
_

3. Did you like Mom/Dad/caregiver helping you answer Becky's questions?



4. Would you like to have video calls with other people?



Sample Semi-structured Interview Questions (Intake):

Thank you for meeting with me today! Today we're going to select three or four questions that you'd like [Child] to answer when talking with you and with other family members during calls. I have a couple of examples to get us started. We're focusing on questions that relatives or other folks that don't see [Child] very often might ask, like

What toys have you been playing with?

What is your favorite movie/music/toy/book/food/etc?

Where did you go this week/today?

We're also choosing questions that have answers that are pictures of places, people, or things that [Child] can identify from a grouping of 3 or 4 other pictures. We'll use these pictures as symbols for [Child] to answer the questions.

What are some questions that you think family and friends will want to ask [Child]?

Sample Semi-Structured Interview Questions (Debrief):

Thank you for meeting with me today! How are you?

We're going to talk about how you feel about the study: the amount of time it took, whether you feel your child learned a lot, whether you feel you learned new skills, etc. We're going to use this form, the TARF-R, to guide our discussion.

[Go through TARF-R items]

Thank you so much for providing all this really great information! Is there anything else you'd like me or future researchers working on projects like this to know or think about?

I want to dive a little deeper into your interactions with [child] during the study. Do you feel that this was time well spent with [child]? Why?

How did the sessions change your interactions with [child]? (For example, were the interactions longer/more positive?)

Were you surprised by anything during the sessions? [For example, at how quickly you or [child] learned new skills?] Provide "for example" if needed.

Thank you so much for talking with me about the study.

Demographics Qualtrics Survey

Family Information

Survey Flow

Block: Default Question Block (18 Questions)

Start of Block: Default Question Block

Q1 Your initials (so I can identify which parent-child duo this information belongs to, this will not be published)

_____

Q17 Your gender identification (will be published/public)

- Male (1)
- Female (2)
- Non-binary / third gender (3)
- Prefer not to say (4)

Q18 Kiddo's gender identification (will be published/public)

- Male (1)
- Female (2)
- Non-binary / third gender (3)
- Prefer not to say (4)

Q19 Your race/ethnicity identity: click as many as apply (will be published/public)

- ☐ White (1)
- ☐ Black or African American (2)
- ☐ American Indian or Alaska Native (3)
- ☐ Asian (4)
- ☐ Native Hawaiian or Pacific Islander (5)
- ☐ Multi-racial (6)
- ☐ Other (7)

Q20 Kiddo's race/ethnicity identity: click as many as apply (will be published/public):

- ☐ White (1)
- ☐ Black or African American (2)
- ☐ American Indian or Alaska Native (3)
- ☐ Asian (4)
- ☐ Native Hawaiian or Pacific Islander (5)
- ☐ Multi-racial (6)
- ☐ Other (7)

Q2 Kiddo's date of birth (used to calculate age at start of project, birthday will not be published but age will be published/public)

_____

Q3 Kiddo's disability/disabilities (will be published/public. Please put what you are most comfortable with making public: diagnosis or descriptors)

_____

_____

_____

_____

_____

Q4 Services kiddo receives at school: choose as many as needed (this will be published/public)

- ☐ special education in general education classroom (no pull-out) (1)
- ☐ special education in special education classroom (2)
- ☐ special education in general education with some pull-out time (3)
- ☐ speech language therapy (includes augcomm) (4)
- ☐ occupational therapy (5)
- ☐ physical therapy (6)
- ☐ assistive technology (7)
- ☐ hearing services (8)
- ☐ vision services (9)
- ☐ behavior supports (yes if kiddo has challenging behavior that impacts their learning and that of others box checked on IEP) (10)
- ☐ nurse/nursing delegation (11)

Q10 Services kiddo receives outside of school: choose as many as needed (this will be published/public)

- ☐ personal support worker (1)
- ☐ speech language therapy (includes augcomm) (2)
- ☐ occupational therapy (3)
- ☐ physical therapy (4)
- ☐ assistive technology (5)
- ☐ hearing services (6)
- ☐ vision services (7)
- ☐ applied behavior analysis services (in home or at a clinic) (8)
- ☐ nurse/nursing delegation (9)

Q5 How many people live in your household? Please put # adults and # kids (this will be published/public)

_____

Q6 What is your highest formal education level completed? (this will be published/public)

- ○ High school (1)
- ○ College/undergraduate (2)
- ○ Graduate (3)

Q7 Which best describes your household income? (this will be published/public)

- ○ Not enough to meet needs (1)
- ○ Just enough to meet needs (2)
- ○ A little more than we need (3)
- ○ Lots more than we need (4)

Q8 What is your zip code (this will be used to report estimated distance from UO when discussing using Zoom for the project)?

_____

Q14 How did you hear about this project? (this will be published/public)

- ○ From a teacher/school staff person (1)
- ○ From a teacher/therapist who works with my child outside of school (2)
- ○ I saw the flyer online (3)
- ○ From a friend/family member (4)

Q11 What did you use most often for this project? (this will be published/public)

- ○ Desktop computer (1)
- ○ Laptop computer (2)
- ○ iPad/similar tablet (3)
- ○ smartphone (4)

Q13 Please provide as much information as possible about your device (brand, model, age, how it connects to the Internet, did you use an external camera or speaker). Example: Apple iPad from 2015 on a tablet stand, used WiFi. (this will be published/public)

_____

Q12 Did you have connection issues when using Zoom for this project? (this will be published/public)

- ○ Yes (1)
- ○ Sometimes (50% of the time) (2)
- ○ No (3)

Q15 Did you have technology or connection challenges that negatively impacted your experience? (this will be published/public)

- ○ Yes (1)
- ○ Sometimes (50% of the time) (2)
- ○ No (3)

End of Block: Default Question Block

APPENDIX E
PARENT TRAINING MATERIALS

PowerPoint for Parent Training on Most-to-Least Prompting

Child Data   Date: Dyad:

Date	Question	0s	3s	CP	Prompted:	Unprompted	
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

Child Data Date: Dyad:

Date	Question	0s	3s	CP	Prompted:	Unprompted	
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

PowerPoint for Parent Training on Progressive Time Delay

Child Data Date: Dyad:

Date	Question	0s	3s	CP	Prompted:	Unprompted	
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

Child Data Date: Dyad:

Date	Question	0s	3s	CP	Prompted:	Unprompted	
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			% correct:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			U:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			P:
		3 2 1 E	Y 3 2 1 E	Y 3 2 1 N			CP:

REFERENCES CITED

Akemoglu, Y., Muharib, R., & Meadan, H. (2019). A systematic and quality review of parent-implemented language and communication interventions conducted via telepractice. *Journal of Behavioral Education*, 1-35.

American Speech-Language-Hearing Association. (n.d.). *Augmentative and Alternative Communication: Key Issues.* Retrieved from: https://www.asha.org/PRPSpecificTopic.aspx?folderid=8589942773&section=Key_Issues

American Speech-Language-Hearing Association. (2018). *2018 Schools survey*. Survey summary report: Numbers and types of responses, SLPs. Available from www.asha.org.

Anderson, K., Balandin, S., & Clendon, S. (2011). "He cares about me and I care about him." Children's experiences of friendship with peers who use AAC. *AAC: Augmentative and Alternative Communication*, *27*(2), 77–90. https://doi.org/10.3109/07434618.2011.577449

Andzik, N.R., Chung, Y.C., & Kranak, M.P. (2016). Communication opportunities for elementary school students who use augmentative and alternative communication. *Augmentative and Alternative Communication*, *32*(4), 272-281.

Asmus, J.M., Carter, E.W., Moss, C.K., Biggs, E.E., Bolt, D.M., Born, T.L., … Weir, K. (2017). Efficacy and social validity of peer network interventions for high school students with severe disabilities. *American Journal on Intellectual and Developmental Disabilities*, *122*(2), 118–137. https://doi.org/10.1352/1944-7558-122.2.118

Barton, E. E., Meadan-Kaplansky, H., & Ledford, J. R. (2018). Independent variables, fidelity, and social validity. In *Single case research methodology* (pp. 133-156). Routledge.

Be My Eyes. (2017). *Be My Eyes* (Version 3.2.3) [Mobile app]. App Store. https://apps.apple.com/us/app/be-my-eyes/id905177575

Bearss, K., Burrell, T.L., Challa, S.A., Postorino, V., Gillespie, S.E., Crooks, C., & Scahill, L. (2018). Feasibility of parent training via telehealth for children with autism spectrum disorder and disruptive behavior: A demonstration pilot. *Journal of Autism and Developmental Disorders*, *48*(4), 1020-1030.

Beukelman, D.R., & Mirenda, P. (2013). *Augmentative and alternative communication: Supporting children and adults with complex communication needs*. Baltimore, MD: Paul H. Brookes Publishing Company.

Boisvert, M., Lang, R., Andrianopoulos, M., & Boscardin, M.L. (2010). Telepractice in the assessment and treatment of individuals with autism spectrum disorders: A systematic review. *Developmental Neurorehabilitation, 13*(6), 423-432. 10.3109/17518423.2010.499889

Bondy, A.S., & Frost, L.A. (1994). The picture exchange communication system. *Focus on Autistic Behavior*, *9*(3), 1-19.

Bopp, K. D., Brown, K. E., & Mirenda, P. (2004). Speech-language pathologists' roles in the delivery of positive behavior support for individuals with developmental disabilities. *American Journal of Speech-Language Pathology, 13*(1), 5-19. 10.1044/1058-0360(2004/003)

Brodhead, M.T., Kim, S.Y., Rispoli, M.J., Sipila, E.S., & Bak, M.S. (2019). A pilot evaluation of a treatment package to teach social conversation via video-chat. *Journal of Autism and Developmental Disorders*, *49*(8), 3316-3327.

Calculator, S.N. (1988). Promoting the acquisition and generalization of conversational skills by individuals with severe disabilities. *AAC: Augmentative and Alternative Communication*, *4*(2), 94–103.

Carnett, A., & Ingvarsson, E.T. (2016). Teaching a child with autism to mand for answers to questions using a speech-generating device. *The Analysis of verbal behavior*, *32*(2), 233-241.

Caron, J., Light, J., & Drager, K. (2016). Operational demands of AAC mobile technology applications on programming vocabulary and engagement during professional and child interactions. *Augmentative and Alternative Communication*, *32*(1), 12-24.

Carroll, R.A., & Kodak, T. (2015). Using instructive feedback to increase response variability during intraverbal training for children with autism spectrum disorder. *The Analysis of Verbal Behavior*, *31*(2), 183-199.

Carter, S.L. (2007). Review of recent treatment acceptability research. *Education and Training in Developmental Disabilities*, *42*(3), 301-316.

Cengher, M., Shamoun, K., Moss, P., Roll, D., Feliciano, G., & Fienup, D.M. (2016). A comparison of the effects of two prompt-fading strategies on skill acquisition in children with autism spectrum disorders. *Behavior Analysis in Practice, 9*(2), 115–125.

Chan, M., & Zoellick, R. (2011). World report on disability. *World Health Organization*.

Chung, Y.-C., Carter, E.W., & Sisco, L.G. (2012). A systematic review of interventions to increase peer interactions for students with complex communication challenges. *Research & Practice for Persons with Severe Disabilities, 37*(4), 271-287.

Cihon, J.H., Ferguson, J.L., Leaf, J.B., Milne, C.M., Leaf, R., & McEachin, J. (2019). A randomized clinical trial of three prompting systems to teach tact relations. *Journal of Applied Behavior Analysis, 9999*, 1-17.

Costigan, F.A., & Light, J. (2010). A review of preservice training in augmentative and alternative communication for speech-language pathologists, special education teachers, and occupational therapists. *Assistive Technology®*, *22*(4), 200-212.

D'Agostino, S. R., Douglas, S. N., & Duenas, A. D. (2019). Practitioner-Implemented Naturalistic Developmental Behavioral Interventions: Systematic Review of Social Validity Practices. *Topics in Early Childhood Special Education*, *39*(3), 170-182.

Dattilo, J., Estrella, G., Estrella, L.J., Light, J., McNaughton, D., & Seabury, M. (2008). "I have chosen to live life abundantly": Perceptions of leisure by adults who use augmentative and alternative communication. *Augmentative and Alternative Communication*, *24*(1), 16-28.

Demchak, M. (1989). A comparison of graduated guidance and increasing assistance in teaching adults with severe handicaps leisure skills. *Education and Training in Developmental Disabilities, 24,* 45-55.

DeSouza, A.A., Akers, J.S., & Fisher, W.W. (2017). Empirical application of Skinner's Verbal behavior to interventions for children with autism: A review. *The Analysis of Verbal Behavior*, *33*(2), 229-259.

Drager, K., Light, J., & McNaughton, D. (2010). Effects of AAC interventions on communication and language for young children with complex communication needs. *Journal of Pediatric Rehabilitation Medicine*, *3*(4), 303-310.

Eikeseth, S., & Smith, D.P. (2013). An analysis of verbal stimulus control in intraverbal behavior: implications for practice and applied research. *The Analysis of Verbal Behavior*, *29*(1), 125-135.

Ennis, R.P., Jolivette, K., Fredrick, L.D., & Alberto, P.A. (2013). Using comparison peers as an objective measure of social validity: Recommendations for researchers. *Focus on Autism and Other Developmental Disabilities*, *28*(4), 195-201.

Feit, A. M., Williams, S., Toledo, A., Paradiso, A., Kulkarni, H., Kane, S., & Morris, M. R. (2017, May). Toward everyday gaze input: Accuracy and precision of eye tracking and implications for design. In *Proceedings of the 2017 Chi conference on human factors in computing systems* (pp. 1118-1130).

Finn, C.A., & Sladeczek, I.E. (2001). Assessing the social validity of behavioral interventions: A review of treatment acceptability measures. *School Psychology Quarterly*, *16*(2), 176-206.

Frederick, J.K., Raabe, G.R., Rogers, V.R., & Pizzica, J. (2020). Advocacy, collaboration, and intervention: A model of distance special education support services amid Covid-19. *Behavior Analysis in Practice, (13),* 748-756. 10.1007/s40617-020-00476-1

Ganz, J.B., Davis, J.L., Lund, E.M., Goodwyn, F.D., & Simpson, R.L. (2012). Meta-analysis of PECS with individuals with ASD: Investigation of targeted versus non-targeted outcomes, participant characteristics, and implementation phase. *Research in Developmental Disabilities*, *33*, 406–418. https://doi.org/10.1016/j.ridd.2011.09.023

Ganz, J.B., Morin, K.L., Foster, M.J., Vannest, K.J., Genç Tosun, D., Gregori, E.V., & Gerow, S.L. (2017). High-technology augmentative and alternative communication for individuals with intellectual and developmental disabilities and complex communication needs: A meta-analysis. *Augmentative and Alternative Communication*, *33*(4), 224–238. https://doi.org/10.1080/07434618.2017.1373855

Gast, D.L., Wolery, M., Ault, M.J., Doyle, P.M., & Alig, C. (1988). *How to use time delay*. Unpublished manuscript, University of Kentucky, Department of Special Education, Lexington.

Gerow, S., Hagan-Burke, S., Rispoli, M., Gregori, E., Mason, R., & Ninci, J. (2018). A systematic review of parent-implemented functional communication training for children with ASD. *Behavior Modification*, *42*(3), 335–363. https://doi.org/10.1177/0145445517740872

Gevarter, C., O'Reilly, M.F., Rojeski, L., Sammarco, N., Lang, R., Lancioni, G.E., & Sigafoos, J. (2013). Comparisons of intervention components within augmentative and alternative communication systems for individuals with developmental disabilities: A review of the literature. *Research in Developmental Disabilities*, *34*(12), 4404–4414. https://doi.org/10.1016/j.ridd.2013.09.018

Ghaddar, S., Vatcheva, K. P., Alvarado, S. G., & Mykyta, L. (2020). Understanding the Intention to Use Telehealth Services in Underserved Hispanic Border Communities: Cross-Sectional Study. *Journal of Medical Internet Research*, *22*(9), e21012. 10.2196/21012

Gibaldi, A., Vanegas, M., Bex, P. J., & Maiello, G. (2017). Evaluation of the Tobii EyeX Eye tracking controller and Matlab toolkit for research. *Behavior Research Methods, 49*(3), 923–946. 10.3758/s13428-016-0762-9

Godby, S., Gast, D.L., & Wolery, M. (1987). A comparison of time delay and system of least prompts in teaching object identification. *Research in Developmental Disabilities*, *8*(2), 283-305.

Graudins, M.M., Rehfeldt, R.A., DeMattei, R., Baker, J.C., & Scaglia, F. (2012). Exploring the efficacy of behavioral skills training to teach basic behavior analytic techniques to oral care providers. *Research in Autism Spectrum Disorders*, *6*(3), 978–987.

Holyfield, C., Drager, K. D., Kremkow, J. M., & Light, J. (2017). Systematic review of AAC intervention research for adolescents and adults with autism spectrum disorder. *Augmentative and Alternative Communication*, *33*(4), 201-212.

Horner, R.H., Carr, E.G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional children*, *71*(2), 165-179.

Houghton, J., Bronicki, G. B., & Guess, D. (1987). Opportunities to express preferences and make choices among students with severe disabilities in classroom settings. *Journal of the Association for Persons with Severe Handicaps*, *12*(1), 18-27.

Iadarola, S., Levato, L., Harrison, B., Smith, T., Lecavalier, L., Johnson, C., Swiezy, N., Bearss, K., & Scahill, L. (2018). Teaching parents behavioral strategies for autism spectrum disorder (ASD): Effects on stress, strain, and competence. *Journal of Autism and Developmental Disorders*, *48*(4), 1031–1040.

Ingvarsson, E. T., & Hollobaugh, T. (2010). Acquisition of intraverbal behavior: Teaching children with autism to mand for answers to questions. *Journal of Applied Behavior Analysis*, *43*(1), 1-17.

Ingvarsson, E. T., & Hollobaugh, T. (2011). A comparison of prompting tactics to establish intraverbals in children with autism. *Journal of Applied Behavior Analysis*, *44*(3), 659-664.

Kent-Walsh, J., & McNaughton, D. (2005). Communication partner instruction in AAC: Present practices and future directions. *AAC: Augmentative and Alternative Communication*, *21*(3), 195–204. https://doi.org/10.1080/07434610400006646

Kent-Walsh, J., Murza, K.A., Malani, M.D., & Binger, C. (2015). Effects of communication partner instruction on the communication of individuals using AAC: A meta-analysis. *Augmentative and Alternative Communication*, *31*(4), 271-284.

Kleinert, H., Towles-Reeves, E., Quenemoen, R., Thurlow, M., Fluegge, L., Weseman, L., & Kerbel, A. (2015). Where students with the most significant cognitive disabilities are taught. *Exceptional Children*, *81*(3), 312–328. https://doi.org/10.1177/0014402914563697

Koch Fager, S., Fried-Oken, M., Jakobs, T., & Beukelman, D.R. (2019). New and emerging access technologies for adults with complex communication needs and severe motor impairments: State of the science. *AAC: Augmentative and Alternative Communication*, *35*(1), 13–25. https://doi.org/10.1080/07434618.2018.1556730

Lancioni, G. E., O'Reilly, M. F., Singh, N. N., Pidala, S., Piazzolla, G., Oliva, D., & Groeneweg, J. (2006). A social validation assessment of cooperative versus individual task engagement of persons with multiple disabilities. *Journal of Visual Impairment & Blindness, 100*(3), 169-173.

Laursen, B., & Hartl, A.C. (2013). Understanding loneliness during adolescence: Developmental changes that increase the risk of perceived social isolation. *Journal of Adolescence*, *36*(6), 1261-1268.

Ledford, J. R., & Gast, D. L. (Eds.). (2009). *Single subject research methodology in behavioral sciences: Applications in special education and behavioral sciences*. Routledge.

Ledford, J.R., Hall, E., Conder, E., & Lane, J.D. (2016). Research for young children with autism spectrum disorders: Evidence of social and ecological validity. *Topics in Early Childhood Special Education*, *35*(4), 223-233.

Lee, N., Vladescu, J.C., Reeve, K.F., Peterson, K.M., & Giannakakos, A.R. (2019). Effects of behavioral skills training on the stimulus control of gun safety responding. *Journal of Behavioral Education*, *28*(2), 187–203.

Leko, M.M. (2014). The value of qualitative methods in social validity research. *Remedial and Special Education*, *35*(5), 275–286. https://doi.org/10.1177/0741932514524002

Light, J., Dattilo, J., English, J., Gutierrez, L., & Hartz, J. (1992). Instructing facilitators to support the communication of people who use augmentative communication systems. *Journal of Speech, Language, and Hearing Research*, *35*(4), 865-875.

Light, J., & McNaughton, D. (2012). The changing face of augmentative and alternative communication: Past, present, and future challenges. *Augmentative and Alternative Communication*, *28*(4), 197–204. https://doi.org/10.3109/07434618.2012.737024

Light, J., McNaughton, D., Beukelman, D., Fager, S.K., Fried-Oken, M., Jakobs, T., & Jakobs, E. (2019). Challenges and opportunities in augmentative and alternative communication: Research and technology development to enhance communication and participation for individuals with complex communication needs. *AAC: Augmentative and Alternative Communication*. https://doi.org/10.1080/07434618.2018.1556732

Logan, K., Iacono, T., & Trembath, D. (2017). A systematic review of research into aided AAC to increase social-communication functions in children with autism spectrum disorder. *Augmentative and Alternative Communication*, *33*(1), 51–64. https://doi.org/10.1080/07434618.2016.1267795

Lorah, E. R., Karnes, A., & Speight, D. R. (2015). The acquisition of intraverbal responding using a speech generating device in school aged children with autism. *Journal of Developmental and Physical Disabilities*, *27*(4), 557-568.

McLay, L., Sutherland, D., Machalicek, W., & Sigafoos, J. (2020). Systematic review of telehealth interventions for the treatment of sleep problems in children and adolescents. *Journal of Behavioral Education*, 1-24.

McCurdy, B. L., Cundari, L., & Lentz, F. E. (1990). Enhancing instructional efficiency: An examination of time delay and the opportunity to observe instruction. *Education and Treatment of Children*, 226-238.

Mace, F.C., & Nevin, J.A. (2017). Maintenance, generalization, and treatment relapse: A behavioral momentum analysis. *Education and Treatment of Children*, *40*(1), 27–42. https://doi.org/10.1353/etc.2017.0001

Machalicek, W., Douglas, A., Drew, C., Barton, H., Erturk, B., & Brafford, T. (in press). Applied Behavior Analysis. In L.M. Glidden, L. Abbeduto, L.L. McIntyre, W. Silverman, & M. Tassé, (Eds.), *APA Handbook of Intellectual and Developmental Disabilities.* American Psychological Association.

Machalicek, W., Lang, R., & Raulston, T.J. (2015). Training parents of children with intellectual disabilities: Trends, issues, and future directions. *Current Developmental Disorders Reports*, *2*(2), 110-118.

Machalicek, W., LeQuia, J., Pinkelman, S., Knowles, C., Raulston, T., Davis, T., & Alresheed, F. (2016). Behavioral telehealth consultation with families of children with autism spectrum disorder. *Behavioral Interventions, 31* (*3*), 223-250.

Maenner, M.J., Shaw, K.A., Baio J., et al. (2020). Prevalence of autism spectrum disorder among children aged 8 years — autism and developmental disabilities monitoring network, 11 sites, United States, 2016. MMWR Surveill Summ 2020;69(No. SS-4):1–12.

Millar, D.C., Light, J.C., & Schlosser, R.W. (2006). The impact of augmentative and alternative communication intervention on the speech production disabilities: A research review. *Journal of Speech, Language, and Hearing Research*, *49*(April), 248–264. https://doi.org/10.1044/1092-4388(2006/021)

Miltenberger, R.G. (2011). *Behavior modification: Principles and procedures*. Belmont, CA: Wadsworth Cengage Learning.

Mirenda, P. (2003). Toward functional augmentative and alternative communication for students with autism: Manual signs, graphic symbols, and voice output communication aids. *Language, Speech and Hearing Services in Schools*, *34*(July), 203–216. https://doi.org/10.1044/0161-1461(2003/017

Morgan, C.A., & Wine, B. (2018). Evaluation of behavior skills training for teaching work skills to a student with autism spectrum disorder. *Education & Treatment of Children*, *41*(2), 223–232.

National Center for Education Statistics. (2019). Fast Facts: Students with disabilities. Retrieved from: https://nces.ed.gov/fastfacts/display.asp?id=64.

National Center for Immunization and Respiratory Diseases, Division of Viral Diseases. (2020). *Prevent Getting Sick: Social Distancing.* https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/social-distancing.html

Nunes, D., & Hanline, M. F. (2007). Enhancing the alternative and augmentative communication use of a child with autism through a parent-implemented naturalistic intervention. *International Journal of Disability, Development and Education*, *54*(2), 177-197.

Park, J.H., Alber-Morgan, S.R., & Cannella-Malone, H. (2011). Effects of mother-implemented picture exchange communication system (PECS) training on independent communicative behaviors of young children with autism spectrum disorders. *Topics in Early Childhood Special Education*, *31*(1), 37-47.

Parker, R.I., & Vannest, K. (2009). An improved effect size for single-case research: Nonoverlap of all pairs. *Behavior Therapy*, *40*(4), 357-367.

Parker, R.I., Vannest, K.J., & Brown, L. (2009). The improvement rate difference for single-case research. *Exceptional Children*, *75*(2), 135-150.

Parker, R.I., Vannest, K.J., Davis, J.L., & Sauber, S.B. (2011). Combining nonoverlap and trend for single-case research: Tau-U. *Behavior Therapy*, *42*(2), 284-299.

Peterson, K.M., Piazza, C.C., Luczynski, K.C., & Fisher, W.W. (2017). Virtual-care delivery of applied-behavior-analysis services to children with autism spectrum disorder and related conditions. *Behavior Analysis: Research and Practice, 17*(4), 286-297. http://dx.doi.org/10.1037/bar0000030

Radley, K. C., Jenson, W. R., Clark, E., & O'Neill, R. E. (2014). The feasibility and effects of a parent-facilitated social skills training program on social engagement of children with autism spectrum disorders. *Psychology in the Schools*, *51*(3), 241–255 10.1002/pits.21749

Raulston, T. Garnett, A., Lang, R. Tostanoski, A., Lee, A., Machalicek, W., Sigafoos, J.,O'Reilly, M., & Didden, R. (2013). Teaching individuals with autism spectrum disorder to ask questions: A systematic review. *Research in Autism Spectrum Disorders*, 7 (7), 866-878.

Reimers, T.M., & Wacker, D.P. (1988). Parents' ratings of the acceptability of behavioral treatment recommendations made in an outpatient clinic: A preliminary analysis of the influence of treatment effectiveness. *Behavioral Disorders*, *14*(1), 7-15.

Reimers, T.M., Wacker, D.P., Cooper, L.J., & de Raad, A.O. (1992). Acceptability of behavioral treatments for children: Analog and naturalistic evaluations by parents. *School Psychology Review*.

Roberts, M.Y., & Kaiser, A.P. (2011). The effectiveness of parent-implemented language interventions: A meta-analysis. *American Journal of Speech-Language Pathology*, *20*, 180–199.

Rosales, R., Stone, K., & Rehfeldt, R.A. (2009). The effects of behavioral skills training on implementation of the picture exchange communication system. *Journal of Applied Behavior Analysis*, *42*(3), 541–549. https://doi.org/10.1901/jaba.2009.42-541

Rowland, C.M., Quinn, E.D., & Steiner, S.A. (2015). Beyond legal: Crafting high-quality IEPs for children with complex communication needs. *Communication Disorders Quarterly*, *37*(1), 53-62.

St. George, D., Natanson, H., Stein, P., & Lumpkin, L. (2020, March). Schools are shut, so how will kids learn amid the covid-19 pandemic? *The Washington Post.* Education. Retrieved April 4, 2020 from https://www.washingtonpost.com/local/education/schools-are-shut-so-how-will-kids-learn-amid-the-covid-19-pandemic/2020/03/22/dac4742e-6ab7-11ea-9923-57073adce27c_story.html

Schlosser, R.W., Sigafoos, J., & Koul, R.K. (2009). Speech output and speech-generating devices in autism spectrum disorders. *Autism spectrum disorders and AAC*. Baltimore, MD: Paul H. Brookes Publishing Company.

Schlosser, R.W., & Wendt, O. (2008). Effects of augmentative and alternative communication intervention on speech production in children with autism: a systematic review. *American Journal of Speech-Language Pathology*, *17*, 212-231.

Schwab, S. (2019). Friendship stability among students with and without special educational needs. *Educational Studies*, *45*(3), 390–401. https://doi.org/10.1080/03055698.2018.1509774

Schwartz, I.S., & Baer, D.M. (1991). Social validity assessments: Is current practice state of the art? *Journal of Applied Behavior Analysis*, *24*(2), 189–204. https://doi.org/10.1901/jaba.1991.24-189

Scruggs, T.E., Mastropieri, M.A., & Casto, G. (1987). The quantitative synthesis of single-subject research: Methodology and validation. *Remedial and Special education*, *8*(2), 24-33.

Simacek, J., Dimian, A. F., & McComas, J. J. (2017). Communication intervention for young children with severe neurodevelopmental disabilities via telehealth. *Journal of autism and developmental disorders*, *47*(3), 744-767.

Skinner, B.F. (1957). *Verbal behavior*. Cambridge, MA: Prentice Hall.

Smidt, A., Balandin, S., Reed, V., & Sigafoos, J. (2007). A communication training programme for residential staff working with adults with challenging behaviour: Pilot data on intervention effects. *Journal of Applied Research in Intellectual Disabilities*, *20*(1), 16–29. 10.1111/j.1468-3148.2006.00336.x

Smith, M.M. (2015). Adolescence and AAC: Intervention challenges and possible solutions. *Communication Disorders Quarterly, 36*(2) 112–118. 10.1177/1525740114539001

Snell, M.E., Chen, L.-Y., Allaire, J.H., & Park, E. (2008). Communication breakdown at home and at school in young children with cerebral palsy and severe disabilities. *Research & Practice for Persons with Severe Disabilities*, *33*(1), 25–36. https://doi.org/10.1080/10910340500534274

Squires, K. (2013). Addressing the Shortage of Speech-Language Pathologists in School Settings. *Journal of the American Academy of Special Education Professionals*, 131-137.

Sparrow, S.S., Cicchetti, D.V., & Saulnier, C.A. (2016). Vineland adaptive behavior scales, (Vineland-3). *PsychCorp.*

Stauch, T., LaLonde, K., Plavnick, J.B., Bak, M.S., & Gatewood, K. (2017). Intraverbal training for individuals with autism: The current status of multiple control. *The Analysis of Verbal Behavior*, *33*(1), 98-116.

Still, K., Rehfeldt, R.A., Whelan, R., May, R., & Dymond, S. (2014). Facilitating requesting skills using high-tech augmentative and alternative communication devices with individuals with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, *8*(9), 1184–1199. https://doi.org/10.1016/j.rasd.2014.06.003

Stockwell, K., Alabdulqader, E., Jackson, D., Basu, A., Olivier, P., & Pennington, L. (2019). Feasibility of parent communication training with remote coaching using smartphone apps. *International Journal of Language & Communication Disorders*, *54*(2), 265-280.

Stokes, T.F., & Baer, D.M. (1977). An implicit technology of generalization. *Journal of Applied Behavior Analysis*, *10*(2), 349–367.

Stokes, T.F., & Osnes, P.G. (1989). An operant pursuit of generalization – republished article. *Behavior Therapy*, *47*(5), 720–732. https://doi.org/10.1016/j.beth.2016.08.012

Suess, A.N., Romani, P.W., Wacker, D.P., Dyson, S.M., Kuhle, J.L., Lee, J.F., ... & Waldron, D.B. (2014). Evaluating the treatment fidelity of parents who conduct in-home functional communication training with coaching via telehealth. *Journal of Behavioral Education*, *23*(1), 34-59.

Sundberg, M.L. (2008). VB-MAPP Verbal Behavior Milestones Assessment and Placement Program: A Language and Social Skills Assessment Program for Children with Autism or Other Developmental Disabilities. Guide, AVB Press.

Sundberg, M.L., & Sundberg, C.A. (2011). Intraverbal behavior and verbal conditional discriminations in typically developing children and children with autism. *The Analysis of Verbal Behavior*, *27*(1), 23-44.

Tager-Flusberg, H., Plesa Skwerer, D., Joseph, R. M., Brukilacchio, B., Decker, J., Eggleston, B., Meyer, S., & Yoder, A. (2017). Conducting research with minimally verbal participants with autism spectrum disorder. *Autism*, *21*(7), 852–861. 10.1177/1362361316654605

Therrien, M.C.S., & Light, J. (2016). Using the iPad to facilitate interaction between preschool children who use AAC and their peers. *AAC: Augmentative and Alternative Communication*, *32*(3), 163–174. https://doi.org/10.1080/07434618.2016.1205133

Therrien, M.C.S., Light, J., & Pope, L. (2016). Systematic review of the effects of interventions to promote peer interactions for children who use aided AAC. *Augmentative and Alternative Communication*, *32*(2), 81–93. https://doi.org/10.3109/07434618.2016.1146331

Tomlinson, S.R., Gore, N., & McGill, P. (2018). Training individuals to implement applied behavior analytic procedures via telehealth: A systematic review of the literature. *Journal of Behavioral Education*, *27*(2), 172-222.

Trembath, D., Balandin, S., & Togher, L. (2007). Vocabulary selection for Australian children who use augmentative and alternative communication. *Journal of Intellectual and Developmental Disability*, *32*(4), 291-301.

Tsami, L., Lerman, D., & Toper-Korkmaz, O. (2019). Effectiveness and acceptability of parent training via telehealth among families around the world. *Journal of Applied Behavior Analysis*, *52*(4), 1113-1129.

Unholz-Bowden, E., McComas, J. J., McMaster, K. L., Girtler, S. N., Kolb, R. L., & Shipchandler, A. (2020). Caregiver training via telehealth on behavioral procedures: A systematic review. *Journal of Behavioral Education*, *29*(2), 246-281.

Valentine, J.C., Tanner-Smith, E.E., Pustejovsky, J.E., & Lau, T.S. (2016). Between-case standardized mean difference effect sizes for single-case designs: a primer and tutorial using the scdhlm web application. *Campbell Systematic Reviews*, *12*(1), 1-31.

Valentino, A.L., Shillingsburg, M.A., & Call, N.A. (2012). Comparing the effects of echoic prompts and echoic prompts plus modeled prompts on intraverbal behavior. *Journal of Applied Behavior Analysis*, *45*(2), 431-435.

Vismara, L.A., McCormick, C.E., Wagner, A.L., Monlux, K., Nadhan, A., & Young, G.S. (2018). Telehealth parent training in the Early Start Denver Model: Results from a randomized controlled study. *Focus on Autism and Other Developmental Disabilities*, *33*(2), 67-79.

Vismara, L.A., McCormick, C., Young, G.S., Nadhan, A., & Monlux, K. (2013). Preliminary findings of a telehealth approach to parent training in autism. *Journal of Autism and Developmental Disorders*, *43*(12), 2953-2969.

Wacker, D.P., Lee, J.F., Dalmau, Y.C.P., Kopelman, T.G., Lindgren, S.D., Kuhle, J., ... & Waldron, D.B. (2013). Conducting functional communication training via telehealth to reduce the problem behavior of young children with autism. *Journal of Developmental and Physical Disabilities*, *25*(1), 35-48.

Walker, G. (2008). Constant and progressive time delay procedures for teaching children with autism: A literature review. *Journal of Autism and Developmental Disorders, 38*(2), 261–275.

Weiner, J.S. (2005). Peer-mediated conversational repair in students with moderate and severe disabilities. *Research and Practice for Persons with Severe Disabilities*, *30*(1), 26–37. https://doi.org/10.2511/rpsd.30.1.26

Whalon, K.J., Conroy, M.A., Martinez, J.R., & Werch, B.L. (2015). School-based peer-related social competence interventions for children with autism spectrum disorder: A meta-analysis and descriptive review of single case research design studies. *Journal of Autism and Developmental Disorders*, *45*(6), 1513–1531. https://doi.org/10.1007/s10803-015-2373-1

What Works Clearinghouse. (2020a). What Works Clearinghouse procedures handbook, version 4.1. *Washington, DC: United States Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance*. https://ies.ed.gov/ncee/wwc/handbooks

What Works Clearinghouse. (2020b). What Works Clearinghouse standards handbook, version 4.1. Washington, DC: *United States Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance*. https://ies.ed.gov/ncee/wwc/handbooks

World Wide Web Consortium Web Accessibility Initiative (2017). *Tools and Techniques*. https://www.w3.org/WAI/people-use-web/tools-techniques/

Wright, C.A., & Kaiser, A.P. (2017). Teaching parents enhanced milieu teaching with words and signs using the teach-model-coach-review model. *Topics in Early Childhood Special Education*, *36*(4), 192-204.

Zablotsky, B., Black, L.I., Maenner, M.J., Schieve, L.A., Danielson, M.L., Bitsko, R.H., Blumberg, S.J., Kogan, M.D., & Boyle, C.A. (2019). Prevalence and trends of developmental disabilities among children in the U.S.: 2009–2017. *Pediatrics*, *144*(4):e20190811.