PROMOTING LANGUAGE AND LITERACY IN CHILDREN WITH COMPLEX COMMUNICATION NEEDS

A Dissertation

by

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ABSTRACT

Individuals with developmental disabilities such as autism spectrum disorder and intellectual disabilities may have complex communication needs and require augmentative and alternative communication (AAC) devices. Low- and high-technology devices can supplement or replace communication in individuals with disabilities. Currently, there is a dearth of studies exploring the language and literacy skills of those with disabilities, and an additional lack of information on the social validity of interventions for individuals that use AAC. Thus, this dissertation seeks to examine these areas. The contents of this dissertation include (1) a single-case experimental design exploring a modified dialogic reading intervention for individuals with autism spectrum disorder and Down Syndrome using a low-technology AAC device, (2) a meta-analysis of storybook reading interventions for individuals with autism spectrum disorder, intellectual disabilities, and physical disabilities that use AAC, and, (3) a systematic review of the social validity, affordability, acceptability, and feasibility of AAC devices used for individuals with ASD and ID.

Results of the single-case experimental design indicated that there was a functional relation between coaching provided to parents online and parent intervention implementation performance. However, no change was observed for child answers to comprehension questions. Findings of the meta-analysis revealed moderate to very strong effects for storybook reading interventions on the language skills of individuals with ASD/ID and physical disabilities. Statistically significant differences were found

for some moderators. Finally, the systematic review revealed researchers collected more subjective than normative data, AAC options appeared to be available for all budgets, and few researchers solicited input about the type of device used prior to the intervention.

These three studies revealed positive outcomes for interventions involving individuals with disabilities who use AAC. Findings revealed that stakeholders can be taught to implement interventions for individuals who use AAC and future studies should utilize more normative data when conducting social validity assessments. Detailed information about the limitations and future directions can be found in each individual study.

DEDICATION

To my family.

To all individuals who have autism spectrum disorder, intellectual disabilities, and complex communication needs.

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CHAPTER I

INTRODUCTION

Individuals with autism spectrum disorder (ASD), intellectual disabilities (ID), developmental disabilities, and complex communication needs often require an alternative means of communication, likely due to communication barriers between partners and child overt behaviors because of an inability to communicate (Drager et al., 2010). Augmentative and alternative communication (AAC) options range from low to high-tech and have dramatically changed as technology has evolved. Use of alternative communication options as a part of a multimodal communication approach have promoted communication (Millar et al., 2006) and language skills in children with complex communication needs (Drager et al., 2006).

Use of AAC as a communication mode during storybook reading interventions has been shown to be an effective approach to increase communication and language skills (Bedrosian, 1999). Specifically, strategies such as scaffolding (Liboiron & Soto, 2006) and AAC modeling (Sennott & Mason, 2016) have been shown to be effective for individuals with disabilities. Moreover, storybook reading interventions increase engagement (Golloher, 2018) and also improve the use of AAC for stakeholders working with individuals who have communication impairments (Senner et al., 2019).

Stakeholders working with individuals who have complex communication needs have many device choices. High-technology has been shown to be the device of choice for many individuals (Beck et al., 2008; Bock et al., 2005; van der Meer et al., 2012),

perhaps because this type of device has more than one use (e.g. browsing the internet, sending a text message, making a phone call, purchasing goods), multiple means to indicate a choice (e.g. picture touch with finger, eye gaze, or head switch), and a variety of ways to present information (e.g. visual scene display, picture choice grids; National Academies of Sciences, Engineering, and Medicine, 2017). In contrast, more advanced communication devices may require repair, a power source, and charging (Iacono et al., 2013). Low-tech AAC, such as communication books or PECS, provides another communication option for individuals with complex communication needs. This may be an appropriate option for individuals with destructive behaviors who have the potential or a history of damaging devices, want a communication option for a less than ideal setting for the use of a communication device (e.g. restroom), would appreciate the ability to quickly make a new communication board or have another copy on hand, or for those who may want a lower cost communication option (Moorcroft et al., 2019). On the other hand, a low-technology device may slow the rate of communication, increase communication effort, or primarily be used as a second option should a high-technology device be out for repair (Iacono et al., 2013). These advantages and disadvantages should be taken into consideration when choosing devices for each individual to promote buy-in and decrease abandonment (Reed & Lahm, 2009).

Evidence suggests that the use of AAC for communication and the provision of AAC during storybook reading interactions are beneficial to the individual; yet, gaps in research are still present. Many studies have utilized shared reading interventions for individuals with ASD or ID (Bellon-Harn & Harn, 2008; Binger et al., 2008; Boyle,

2018), but none of the studies have utilized parents as interventionists in a telehealth delivery model. Moreover, systematic reviews have been conducted on children's storybook reading interventions for those with complex communication needs (Boyle, et al., 2019; Hudson & Test, 2011), but none of the reviews have investigated oral language outcomes for individuals with complex communication needs who use AAC. Finally, researchers have conducted qualitative studies of AAC device social validity, but none have used single-case designs.

Chapter II of this dissertation explored the use of a parent-implemented modified dialogic reading intervention conducted via telehealth. The research questions for this study are: (a) what is the effect of parent coaching via telepractice on the parent implementation of modified dialogic reading procedures?; (b) what is the effect of parent coaching of modified dialogic reading strategies delivered via telepractice on the language skills of young children with developmental disabilities?; and (c) what are parents' opinions of the goals, outcomes, and procedures of this intervention?

Chapter III includes a meta-analysis of single-case studies involving the impact of children's picture books on language skills of children who use AAC. The research questions are: (a) What is the magnitude of effect of storybooks used as intervention tools on the communication outcomes of school-age children with ASD or ID who use AAC?; (b) What is the magnitude of effect of storybooks used as intervention tools on the communication outcomes of school-age children with physical disabilities?; (c) How do study characteristics including front-loading, book type, and AAC type moderate the

efficacy of shared book reading interventions?; and (d) What are the descriptive features of front-loading, book type, and AAC type?

Chapter IV systematically reviewed social validity, affordability, acceptability, and feasibility of augmentative and alternative communication (AAC) devices used for individuals with ASD and ID. The research questions are: (a) What elements of pre- and post-intervention subjective and normative social validity data have been collected as a part of interventions including participants with ASD or ID who use augmentative and alternative communication?; (b) What is the affordability, acceptability, and feasibility of augmentative and alternative communication devices used in interventions for students with ASD and ID?; and (c) How has reporting of subjective and normative data for goals, procedures, and outcomes of studies changed over time?

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CHAPTER II

COACHING PARENTS OF CHILDREN WITH DEVELOPMENTAL DISABILITIES TO IMPLEMENT A MODIFIED DIALOGIC READING INTERVENTION USING LOW-TECHNOLOGY VIA TELEPRACTICE*

The ability to proficiently read is a skill that is important for participation in society and one that is often taken for granted. Approximately 43 million individuals are not able to interact with texts at a basic level (Organization for Economic Cooperation and Development, 2013) which impacts academic outcomes (Sonnenschein et al., 2010), relationships (Miles & Stipek, 2006), employment (United States Department of Education, NCES), and quality of life (DeWalt et al., 2004). These difficulties likely start at an early age and continue into adulthood.

A recent study by the Center for Disease Control found 16% of parents interviewed had a child with a developmental disability such as autism spectrum disorder (ASD) or intellectual disability (ID; Zablotsky et al., 2019). The reading profiles of individuals with ASD and ID can be variable with some individuals demonstrating an exceptional ability to decode words while others struggle to comprehend what is read (Nation et al., 2006; Ratz, 2013). There are numerous

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* Reprinted with permission from "Coaching Parents of Children With Developmental Disabilities to Implement a Modified Dialogic Reading Intervention Using Low-Technology via Telepractice" by Lauren M. Pierson, Julie L. Thompson, J. B. Ganz, Sanikan Wattanawongwan, April N. Haas and Valeria Yllades, 2021. American Journal of Speech-Language Pathology, 30, 119-136, Copyright [2020] by American Speech-Language-Hearing Association. https://pubs.asha.org/doi/10.1044/2020_AJSLP-20-00037

treatment methods and tools that can be tailored to the relative strengths and weaknesses associated with developmental disabilities.

Children's picture books are a part of many families' daily routines. Children who are read to beginning in early childhood have been shown to have increased later literacy skills (American Academy of Pediatrics [AAP], 2017). Books can increase the number of different words children hear which also predicts later vocabulary levels (Hart & Risley, 2003). Storybooks are also used by educators, speech-language pathologists, and other stakeholders to teach concepts and help generalize skills previously taught to children with and without disabilities in a naturalistic context (Satterlund, 2016; Ukrainetz, 2005; Ukrainetz & Trujillo, 1999). Early childhood educators use books to reinforce skills during large group activities, typically have classroom libraries, and provide tubs of books for children to read during center time (Kaderavek & Justice, 2002). Researchers have also used storybooks as intervention tools which have resulted in improvements in language skills (e.g., Hargrave & Sénéchal, 2000; Huebner, 2000; Lever & Sénéchal, 2010; Lonigan & Whitehurst, 1998; Snow & Goldfield, 1983; Whitehurst et al., 1988). Specifically, shared storybook reading has been used with individuals who have language impairments (e.g., Justice et al., 2018), are typically developing (e.g., Skibbe et al., 2018), have ASD (e.g., Fleury & Hugh, 2018), and have Down syndrome (e.g., Lim et al., 2018).

Dialogic Reading

Dialogic reading (DR) is a specific treatment package deemed by the What Works Clearinghouse (2010) of the U.S. Department of Education as an intervention that

has "potentially positive impacts" on the language skills of children who have disabilities. Researchers have used DR in a variety of settings such as the home with parents as interventionists, and training procedures frequently use didactic teaching with incorporated modeling. In addition, it appears that positive outcomes may still be a result for studies that do not fully implement all DR procedures (Towson et al., 2017), thus providing more room for adaptations to be made to meet the needs of those with differing ability levels (Whalon et al., 2013).

The initial use of DR was introduced by Whitehurst and colleagues in which they provided general DR procedures consisting of prompting the child to communicate by asking different types of questions, providing a response to the child by expanding upon their utterance or modeling the correct response, and introducing more complex questions as the child is ready (Whitehurst et al., 1988). DR procedures were expanded to include two parts to instruction. Part one included prompting the child by asking "what" questions, following up with questions, incorporating models of correct language, providing praise, following the child's lead, and encouraging the implementer to promote dialogue. Part two consisted of the introduction of more complex questions and expanding what the child said to model more syntactically complex utterances (Arnold et al., 1994). The approach was then formalized using the mnemonic (PEER) and (CROWD) (Burns et al., 1999; Whitehurst et al., 1994). The PEER mnemonic stands for Prompt, Evaluate, Expand, and Repeat. The CROWD mnemonic stands for Completion, Recall, Open-Ended, Wh- questions, and Distancing. Strategies for PEER include *Prompt* child participation by asking one of the CROWD questions, *Evaluate* the

accuracy of the child response, *Expand* the child's response by verbally adding additional words to the response the child gives and provide praise (e.g., "great job!," high-five, "way to go!"), and then ask the question again (*Repeat*). *Completion* questions are those requiring the child to fill-in-the-blank with an appropriate answer. *Recall* questions are those that recall specific details from the story that have already been read. *Open-ended* questions are those that require inferencing skills or recognition of emotions. *Wh- questions* are those that begin with words such as "who," "what," or "where" and can be answered based on the information from the page. *Distancing* questions are those that relate the concepts from the book to personal experiences. Researchers such as Fleury and Schwartz (2017) have modified the intervention by utilizing a system of least prompts in their intervention with children who have ASD. Paraprofessionals delivered least intrusive to most intrusive prompts when children provided the incorrect answer to a question or did not answer the question (Fleury & Schwartz, 2017). In this study, the PEER strategy was also modified to accommodate the needs of individuals with intellectual and developmental disabilities by providing a system of least prompts (i.e., Extend) (American Speech-Language-Hearing Association [ASHA], 2006; Hudson et al., 2014; Mims et al., 2009). Should the child give an incorrect answer to a comprehension question, parents were taught to implement the Extend strategy which included (1) provision of answer choices for participants with greater communication needs, (2) verbal prompts such as repeating the question, redirection to the task, or rephrasing the question, (3) reduction of answer choices, (4) gestural prompts such as pointing to the picture of the correct answer while verbally

saying the correct answer, and (5) full physical prompts moving the child's hand to the picture of the correct answer.

Augmentative and Alternative Communication

Research has also been extended for use with individuals who require augmentative and alternative communication due to speech-language deficits (AAC; Browder et al., 2011; Lund et al., 2017; Mucchetti, 2013). Specifically, those with ASD or ID may have communication abilities ranging from non-verbal to individuals with mild social-communication deficits (Boat & Wu, 2015; Kasari et al., 2013; Tager-Flusberg & Kasari, 2013), necessitating the need to choose the appropriate AAC system according to individual ability level. Forms of AAC range from unaided/no-tech (e.g., utilizes body parts and no other equipment), low-tech (e.g., picture book, picture board), or high-tech (e.g., dedicated communication device, technology application) (Ganz & Simpson, 2019). AAC may supplement residual speech or replace oral communication for those lacking skills (Hustad & Miles, 2010), while the use of multiple communication modalities (e.g., oral speech, signing, and picture book) may be the most feasible way for individuals to get their message across (Ganz & Simpson, 2019).

Telepractice

The delivery of interventions via technology for individuals with disabilities is becoming more common (Nelson et al., 2018). Telepractice can be defined as the use of technology as a medium to connect clients, interventionists, and individuals with other areas of expertise for the purposes of assessment and intervention. Benefits of telepractice over traditional service delivery options include lower costs, higher

treatment acceptability, and access to features such as screen sharing to enhance communication and education (American Speech-Language Hearing Association Telepractice, n.d.; Reese et al., 2013; Sutherland et al., 2018; Wales et al., 2017). The delivery of intervention procedures using technology incorporates three participation models which includes synchronous, asynchronous, and hybrid. Asynchronous models allow stakeholder to access material (e.g., written instructions, video examples, online training content) at a convenient time. Synchronous models are characterized by live meetings held via online platforms or the telephone. Finally, hybrid models are those that use both synchronous and asynchronous models. Stakeholders involved in interventions via telepractice report a better understanding of the concepts introduced asynchronously when elaborated upon during synchronous sessions, increased opportunities to provide feedback to those implementing interventions, and more confidence in implementing the intervention through discussion (Chung et al., 2020).

Coaching

While using telepractice, researchers use various coaching procedures. Aspects of coaching include viewing the stakeholder implement the intervention procedures (e.g., live or uploading a video for later viewing) and the provision of written and verbal feedback, making sure to also provide praise. Self-reflection and the inclusion of a time for questions are also helpful (Snodgrass et al., 2017). Researchers who have implemented interventions delivered via telepractice models have reported positive treatment outcomes (Coufal et al., 2018; Gabel et al., 2013). In a study by Simacek and colleagues, researchers coached parents to conduct a Functional Analysis and Functional

Communication Training (FCT) procedures at a distance. Results indicated that child requesting skills demonstrated by both low-tech and high-tech modalities improved as a result of the coaching procedures delivered via distance. Researchers discussed benefits of telepractice delivery which included a lower cost alternative to face-to-face delivery and use of the FCT intervention to add to the interventions already being provided (Simacek et al., 2017). In another study, parents of children with ASD were coached to deliver a communication intervention via distance. Parents demonstrated the ability to deliver the intervention components to their child and increases in child communication skills were noted. Researchers indicated that telepractice offered an on demand format conducive to busy schedules that likely reduced the chance of parents dropping out of the intervention (Douglas et al., 2018). While the results of these studies are promising, no studies using telepractice to deliver storybook reading interventions with AAC as a response mode to individuals with developmental disabilities were found to have been published. Researchers trained parents to implement storybook reading intervention procedures via a hybrid approach to telepractice.

The purpose of this study was to determine if telepractice can be used to teach parents of children with developmental disabilities to implement modified dialogic reading procedures with fidelity. A low-tech communication option was available to all participants. Research questions include:

Research Question 1: What is the effect of parent coaching via telepractice on the parent implementation of modified dialogic reading procedures?

Research Question 2: What is the effect of parent coaching of modified dialogic reading strategies delivered via telepractice on the language skills of young children with developmental disabilities?

Research Question 3: What are parents' opinions of the goals, outcomes, and procedures of this intervention?

Method

Experimental design

A multiple probe across participants design was used for this study. The primary dependent variable for this study was parent implementation of the modified dialogic reading procedures, and the secondary dependent variable was the number of comprehension questions the child answered correctly. The baseline condition consisted of the parent reading the storybooks in absence of modified dialogic reading training via telepractice. The intervention condition was characterized by the parent receiving training and coaching on the modified dialogic reading strategies via telepractice. Condition changes were made when parent implementation data for modified dialogic reading procedures were stable. Participants in subsequent tiers began intervention when intervention data (i.e., three data points) for participants in preceding tiers were stable or demonstrated a downward trend. The next tier's stability was determined in terms of trend more so than variability. Some variability was acceptable due to the naturalistic nature of this intervention. Randomization was used for all elements of baseline and

intervention including participant order in tiers, book reading calendars, and videos assigned for interobserver agreement (IOA).

Participants and Settings

Participants were recruited from the south central United States. Institutional review board approval at Texas A&M University was obtained prior to study implementation (number IRB2019-1744D). Potential participants were recruited by distributing flyers and letters to childcare centers, libraries, preschools, parents, individuals at universities, clinics, and early childhood centers. Approximately 30 contacts were made for the recruitment of participants. Inclusion criteria for child participants were (a) English as a primary language, (b) ages five to eight years, (c) scores of below or well below expected on the Peabody Picture Vocabulary Test-5th Editions (PPVT-5; Dunn, 2018) which indicates their ability level is below that of peers, (d) evidence of a developmental disability determined by educational eligibility or medical diagnosis of intellectual disability, ASD, and/or developmental delay, (e) ability to stay engaged in an activity for approximately three to ten minutes with assistance, (f) ability to point to 10 white index cards on pages attached to ten different pages of a book during a book reading activity, and (g) answer 80% or less comprehension questions about a storybook correctly. Inclusion criteria for parents were (a) previous experience reading to their child, (b) willingness to follow treatment procedures, (c) willingness to participate in online meetings for coaching sessions, and (d) willingness to work with their child each week to implement the intervention strategies. Speaking English and

access to technology were not specific parent inclusion criteria for this study, although both were determined at the initial parent meeting held online.

First, the interventionist met with each family online to determine if they and their children met inclusionary criteria for the study. Second, the interventionist met with the parents and children in person at their home to complete the initial book reading activity, parent interview, Peabody Picture Vocabulary Test-Fifth Edition (PPVT-5; Dunn, 2018), and the Vineland Adaptive Behavior Scales-3 (VABS-3; Sparrow et al., 2016). Five families were assessed for participation and four families met inclusion criteria. One dyad did not meet inclusion criteria due to PPVT-5 scores that were in the expected range in relation to peers and the ability to answer 100% of comprehension questions about a storybook correctly. Three parent child dyads and one parent child triad participated in the study. Family members could be occasionally seen or heard in background of videos. Refer to Table 1 for the Parent Demographic Information and Table 2 for the Child Demographic Information.

Aaron (Anna)

Aaron, a male participant, was 7 years 3 months of age at the start of the study. Diagnoses of ASD and speech-language delay were reported. Anna (age 43), mother of Aaron, implemented the intervention. Ethnicity information was requested by the interventionist; however, Anna was not responsive to contacts following completion of the intervention condition. Aaron used items/activities such as time on the computer, making baked goods, candy, and watching a television program as reinforcers during baseline and intervention.

Benjamin (Candace)

Benjamin, a Hispanic Caucasian male participant, was 5 years 9 months of age at the start of the study. Parent provided results of VABS-3 recently given to child by school district personnel. A primary educational diagnosis of ASD and secondary diagnoses of speech-language impairment and pragmatic language impairment were reported. Candace (age 50), mother of Benjamin, implemented the intervention. Benjamin was not observed to use a preferred item as a reinforcer at the end of the book reading sessions.

Isaac (Jared and Leah)

Isaac**,** a Caucasian male participant, was 5 years of age at the start of the study. Medical and educational diagnoses of ASD, anxiety, expressive and receptive language delays, and global developmental delay were reported by the parent. Isaac was able to stay in the area and engaged in the book reading activity when held by his mother. Leah (age 34), mother of Isaac, primarily implemented the intervention. Jared (age 35), father of Isaac, also participated. Mother and father were in attendance at all training and parent coaching sessions. Isaac used items such as sensory toys that vibrated, malleable dough, and the opportunity to read a book of choice as reinforcers.

Solomon (Ruth)

Solomon, a Caucasian male participant, was age 6 years 1 month at the start of the study. Medical diagnoses of Down syndrome, global developmental delay, and pediatric restless leg syndrome were reported by the parent. Ruth (age 38), mother of

Solomon, implemented the intervention. Solomon most frequently used the game Shark Bite as a reinforcer after book reading sessions.

Interventionist

The primary researcher and study implementer was a doctoral student with ten years of experience working with children who have disabilities in clinical and educational settings.

The interventionist held a Master of Science degree in Communication Disorders, state teaching certifications, and speech-language pathology licensure at the time of the study. All interviews, assessments, training, and coaching sessions were completed by the interventionist. The interventionist did not have a prior relationship with any participants with the exception of Candace who was involved in a parent training project where the interventionist served as her parent coach.

Materials

Book Selection

Four sets of five commercially available children's books were purchased for the intervention. Books were chosen from a list of books provided by Owens and Robinson (1997) if they were descriptive, narrative, contained appealing illustrations, contained words, and were appropriate for children in pre-kindergarten to second grade. Each book was less than $4.50. The five books used during the dialogic reading procedures were *Charlie Needs a Cloak* [de Paola, 1973], *Geraldine's Blanket* [Keller, 1988], *The Knight and the Dragon* [de Paola, 1998], *Rosie's Walk* [Hutchins, 1968], and *Alexander and the Terrible, Horrible, No Good, Very Bad Day* [Viorst, 1972]. The interventionist wrote the

page number in the corner of each book page using a black marker prior to the intervention.

Questions and Picture Answer Choices

The person conducting the intervention typically prepares CROWD questions related to the book prior to the book reading activity. During the book reading activity, the stakeholder moves through the steps of the modified dialogic reading strategy beginning with Prompt. Stakeholders working with individuals with disabilities can use the techniques combined with the most appropriate mode of communication for the child to enhance oral language skills (Morgan & Meier, 2008). For the purposes of this study, the interventionist created questions using the CROWD framework. Questions developed were appropriate for the listening comprehension levels of children in grades kindergarten through second grade. At least two inference questions (*Open-ended)*, approximately an equal number of *Recall* and *Wh- questions*, and one *Distancing* question were constructed for each question set. The page number corresponding to the book page for which the parent was to ask the question was written before each question. Three different sets of 10 questions were created for each book and four picture answer choices were created for each question. A combination of photographs taken directly from the picture book and stock photos taken from the web were obtained for each comprehension question picture answer choice. Stock photos from the web were taken when there was not a good picture from the book. For example, if milk was the answer to a CROWD question and there were no available visuals from the book, a stock photo was found depicting milk. Picture answer choices (approximately 1”x1”) were centered

in four attached black boxes (approximately 2”x2”) under each question, and five questions with picture answer choices were located on each page. Use of picture answer choices was considered low-tech AAC for this study. Question and answer sets were printed in color on white cardstock. Each set was color coded using green, pink, or orange circular labels ¾” in diameter. The interventionist wrote the number of each question set in the center of the circle with a black marker and placed each circle in the top right corner of the question set page. The intervention materials were hole punched, organized by book title using dividers, and placed in a three-ring binder. Book choices and CROWD questions with picture answer choices were reviewed by an expert in literacy prior to the implementation of the study.

Book Reading Calendars

Parents were provided with four calendars of book readings. Books were read in the order listed on the calendar. The interventionist randomly ordered books using a random number generator for baseline, intervention, and maintenance sessions (Haahr, 2010). Another book was chosen if the same book was drawn two times in a row. Each family received a different calendar.

Reinforcers

A First-Then board created by the interventionist and provided to the parent was used to motivate the student to complete the storybook reading tasks (Premack, 1959). A picture of a book was printed in the “First” box and reinforcing items (e.g., item/activity name written on a piece of paper) were placed in the “Then” box by the parent. Parents

chose reinforcers based on the results of the preference assessment and/or their knowledge of child preferences.

Technology

Training and coaching sessions were completed on WebEx, a secure, HIPAA compliant, free, web-based platform. Parents accessed WebEx and recorded book reading session videos using their computer, tablet, or smartphone. Parents also used Google Drive to upload their storybook reading videos and access intervention materials. The interventionist provided written and oral directions during the baseline training meeting to assist parents with uploading the videos to the Google Drive.

Independent Variable

The independent variable for this intervention was parent reading of storybooks with modified dialogic reading procedure training and coaching via telepractice. The interventionist trained parents to implement the baseline and dialogic reading procedures during one training session for each condition.

Anticipatory Set

Intervention procedures incorporated an anticipatory set which served as a way to activate prior knowledge (Klingner et al., 2015). Anticipatory set procedures were used during the storybook reading intervention to preview elements of the story, generate conversation about the front cover of the book, or talk about what may happen in the book based on the pictures (Spooner et al., 2009, 2014). The parents were instructed to begin the storybook session by handing the book to their child. Parents encouraged the child to look at the title, point to it, and then the parent read the title. The parents

discussed the pictures on the front of the book using the child's preferred communication modality. Next, the parent prompted the child by saying, "What do you think this story will be about?" Then, the parent talked about an experience related to something seen on the front cover of the book. Finally, the parent was asked to respond to their child and follow their lead in terms of conversation interest. Procedures for the anticipatory set can be found in the supplementary material.

Training

Intervention training consisted of didactic teaching using an interventionist prepared presentation. Didactic teaching is a systematic delivery method for teaching information (Albaradie, 2018). The synchronous presentation began with a discussion about the benefits of reading storybooks to children (Hargrave & Sénéchal, 2000; Huebner, 2000; Lever & Sénéchal, 2010; Lonigan & Whitehurst, 1998; Strasser et al., 2013) and a discussion of common concerns related to storybook reading followed. The interventionist then introduced dialogic reading using a combination of text and a video (Lonigan, 2011a). Levels of CROWD were introduced using a video and text (Lonigan, 2011b). The PEEER portion of the intervention was introduced through text with definitions of each of the parent implementation strategies. Then, the interventionist presented a video of the intervention being implemented to children in a group format (CONNECT Modules). Instruction on the system of least prompts followed and parents were taught a prompting hierarchy to be used during the intervention (Ledford & Chazin, 2016). The parents engaged in role play activities in which the parents and interventionist played the role of parent and child during a book reading activity. First,

the interventionist presented a sample storybook and related CROWD questions. The interventionist played the role of the parent and the parent played the role of the child. Then, the parent played the role of the interventionist using one of the interventionist provided books or a book of their choice. Instructions for the reading procedure were presented on the screen to help the parent move through the strategies. The interventionist provided verbal feedback about the parent's role playing performance.

Asynchronous portions of the intervention consisted of provision of the presentation and a cheat sheet for future reference. The cheat sheet contained information about setting up the book reading session, the anticipatory set procedures, CROWD questions, and PEEER strategy. A flow chart for the intervention procedures can be found in the supplementary material.

Coaching

Parents participated in synchronous coaching sessions occurring one time per week on a mutually agreeable day and time. Prior to the meeting, the interventionist watched all of the recorded videos the parent uploaded the week prior to the meeting and prepared written feedback (i.e, asynchronous activities). During the meeting, at least one video clip was watched and verbal feedback was provided. Feedback was provided on the preparation of materials and implementation of the anticipatory set. The parents were shown graphs depicting parent fidelity of the modified dialogic reading intervention data and the number of questions the child was able to answer correctly data. Narrative feedback about overall parent performance and child behavior were given. Parent behaviors were modeled and/or role play occurred. Feedback specific to the

communication needs of each child participant was also given. For example, Leah, Jared, and Ruth were encouraged to elicit verbal communication by verbally modeling the correct answer and providing explicit prompts such as, “tell me hen.” Anna and Candace were encouraged to use more open-ended questions during generalization book readings and provide more syntactically complex expansions. An increase in wait time and use of less intrusive prompts were also suggested during coaching sessions. Coaching sessions lasted approximately 60 minutes.

Dependent Variable and Measures

Primary Dependent Variable

The primary dependent variable was the parent implementation of the modified dialogic reading intervention procedures. Parent behavior responses were the correct implementation PEEER components of the modified dialogic reading strategy for each question asked during each book reading session. For the purposes of this modified dialogic reading intervention, the Evaluate component was not measured because the author considered it to be a private event inside of the parent. Data reported as averages for the PEEER and anticipatory set strategies can be found in Figure 1 for Parent Percentage of Strategies Used.

Secondary Dependent Variable

The secondary dependent variable was child answers to comprehension questions that are *Correct*, *Prompted Correct*, *Prompted Incorrect*, or *Incorrect*. Raters evaluated child answers according to descriptions located in Table 3, which contains the Child Comprehension Question Answer Descriptions. Revealing the picture answer choices for

Aaron and Benjamin was counted as a prompt because they initially demonstrated high rates of independent correct responses during the first four baseline probes. Isaac and Solomon were allowed to see the picture answer choices due to lower rates of independent correct responses during the first four baseline probes. *Correct* and *Prompted Correct* child data for the secondary dependent variable can be found in Figure 2 which is Child Percentage of Comprehension Questions Answered. Both are reported as percentages.

Assessment Measures

The PPVT-5 and VABS-3 were used as one part of the assessment process. The PPVT-5 is a norm-referenced measure used to assess vocabulary skills and designed to be part of a comprehensive language evaluation. The VABS-3 is a norm-referenced assessment used to assess adaptive behavior skills and was used as a measure to describe current functioning for the purposes of this study.

Procedure

Baseline

Prior to baseline, one training session lasting an average of 20 minutes and provided via telepractice was conducted for each family. The session began by reviewing the binder and storybooks provided by the interventionist. The binder included the question sheets, first/then board, and preference assessment data sheets. Parents were taught to administer free operant preference assessments. The free operant procedure was chosen because of ease of implementation (Chazin & Ledford, 2016). Directions for the free operant procedure included (1) setup the environment with toys to

choose from or move to a natural environment where toys are already available, (2) observe if the child walks up to an item or picks up the item and the length of time the child interacts with the item, (3) record information about each item the child engages, and (4) list items that are present but were not motivating for the child. Participants were provided the data sheet created by Chazin and Ledford (2016). Parents were encouraged to use preferred items or activities chosen by the child during the preference assessment as reinforcers during the baseline condition.

Procedures for before, during, and after reading were reviewed. Before reading, parents were instructed to find a quiet place for each book reading session, gather the first/then board, place the storybook in front of the child, and place the answer choices in front of the child. During reading, parents were instructed to read the words on the page, talk about the page, and then read the question corresponding to the page number being read because this type of exchange is a part of natural caregiver reading behavior (Bus & Ijzendoorn, 1997; Symons et al., 2010). Reading the question corresponding to the page number being read in this condition was done to allow for consistent data collection between baseline and intervention conditions. After reading, parents were told to upload the video to the drive within 24 hours of the book reading session. Parents were instructed to refrain from delivering prompts related to the question during the baseline condition. Parents were asked to video record three to four book reading sessions per week.

Intervention

One intervention training session lasting an average of 60 minutes and provided via telepractice was completed for each family. Before reading procedures were identical to the baseline condition. During reading, parents were instructed to read the words on the page, talk about the page, read the question corresponding to the page number being read, and carry out the remainder of the PEEER steps. Parents were encouraged to record one video per day. If more than one video per day needed to be recorded, parents were instructed to wait at least one hour between book reading sessions.

Generalization

Generalization data were collected during baseline, intervention, and maintenance conditions. Parents were instructed to read a book that they own or one from the library in the same place they are conducting baseline and intervention sessions. Parents formulated ten questions based on the CROWD questioning strategy and no instructions were given in regards to the answer choice format. Procedures for generalization were the same as intervention.

Maintenance

Maintenance data were collected one week after the intervention condition ended. The same procedures were followed for the intervention condition. A coaching session was not provided during the week maintenance took place. An interventionist provided book and a generalization book chosen by each family were read during the maintenance condition. Maintenance data were collected for Benjamin, Isaac, and Solomon.

Data Collection

Continuous recording procedures and counts were used to determine the frequency of behaviors (Ledford & Gast, 2018). All baseline, intervention, and maintenance book reading sessions were video recorded by parents. The first author watched, coded, and graphed data from all videos. Parent and child data were collected using a checklist that can be provided by the first author upon request. Averages related to PEEER and the anticipatory set were calculated by dividing the total number of strategies the parent implemented by the total number of possible opportunities the parent had to implement the strategy and multiplying that quotient by 100. In addition, data for the number of modified dialogic reading component implementation opportunities missed per condition and the percentage of components correctly implemented can be found in Table 4, which contains the Number of Modified Dialogic Reading Component Opportunities Missed Per Condition. The number of opportunities missed per condition was calculated by counting the number of times the parent did not implement a strategy when given the opportunity.

IOA

Three doctoral students with previous experience conducting single-case studies completed IOA. Raters were masked to the study condition and trained by the first author with a small number of videos to at least 80% agreement. Data were collected for approximately 30% of the data points for all participants in all conditions. Retraining occurred if agreement was below 80% for the anticipatory set, child independent answers to comprehension questions, or parent implementation of the PEEER strategy.

Disagreements were resolved via discussion. Agreement calculations were calculated using point-by-point agreement which is the number of agreements divided by number of agreements plus disagreements multiplied by 100 (Ledford & Gast, 2018). Four IOA percentages across two observers were lower than 80% due confusion about the timing of anticipatory set procedures, failure to indicate Extend was used if prompts were delivered, and counting other plausible answers to Distancing questions as correct. Retraining occurred following these four instances.

Training Fidelity and Procedural Integrity

Training fidelity data were collected for the sessions in which the interventionist trained the parent to carry out the baseline or intervention procedures via video. Baseline training for Anna was not recorded due to a recording malfunction. Procedural integrity data were also collected for 100% of the coaching sessions in which the interventionist gave the parent feedback about the book reading session videos. A second rater watched the videos and a percentage of agreement was taken. Agreement for one training fidelity video was below 80%, thus retraining was necessary in that instance. Data for Procedural Integrity, Training Fidelity, and Interobserver Agreement are presented in Table 5.

Social Validity

A social validity survey soliciting parent ratings in the form of a five-point Likert scale was adapted from a questionnaire developed by Roberts and Leko (2013). Parents completed the survey in the middle of the intervention condition. Feedback from parents was discussed and integrated into the intervention. Survey components included rating

of the ease of use of procedures, materials, generalizability of intervention with other people in their home, cost effectiveness of intervention, and overall rating of parent views on effectiveness of intervention and appropriateness of treatment goal.

Visual Analysis

The data were analyzed using visual analysis. Analysis of data within and between conditions was completed. The interventionist analyzed the data based on level, trend, variability, immediacy of effect, and stability (Vannest & Ninci, 2015). The interventionist expected a low, stable level trend for baseline data followed by a gradual increase in data for the intervention condition.

Statistical Analysis

Statistical analyses accompanied the visual analysis component for this intervention. Tau-*U* was used as the primary statistical analysis tool because all data points can be used, it allows for control of baseline trend, and has high sensitivity (Parker et al., 2011). Data were analyzed using a free online Tau-*U* calculator (Vannest et al., 2016). Tau-*U* values range from -1 to 1. Effects can be interpreted as 0.93-1.00 (strong to very strong), 0.80-0.92 (moderate effects), 0.65-0.79 (low effects), and (≦ 0.64) no to very low effects (Ganz et al., 2017).

Results

Statistical analysis of data revealed an omnibus Tau-U value for parent PEEER implementation of 0.82 (90% CI [0.5655, 1]), indicating that parent training and coaching via telepractice had a moderate effect on parent implementation of modified dialogic reading procedures. Individual effects for individual parents ranged from 0.64 to

1.00. Effect sizes align with visual analysis. The effect size for Anna was 1.00 (strong to very strong effect), Candace was 0.68 (low effect), Leah and Jared was 0.64 (no to very low effect), and Ruth was 0.96 (strong to very strong effect).

Parent Implementation Data

Anna

Data for parent implementation of PEEER components during baseline have no trend (average = 54%, range = 50%-57%). An immediacy of effect can be observed for data between baseline and intervention. Data for PEEER strategy implementation during intervention are variable and have no trend (average= 90%, range = 82%-97%). Generalization data were 50% in baseline while data in intervention were 84% and 100%. Data for anticipatory set strategy implementation in baseline have no trend or variability (average = 20%, range = 20%-20%). An initial immediacy of effect can be observed between baseline and intervention conditions. Intervention data are variable with no trend at the beginning of intervention and a decreasing trend toward the end of intervention (average = 63%, range = 20%-80%). Generalization data were 20% in baseline, while data in intervention were 80% and 60%. Maintenance data were requested by the interventionist; however, Anna was not responsive to contacts following completion of the intervention condition.

Candace

Data for parent implementation of PEEER components during baseline are variable and have no trend (average = 68%, range = 58%-78%). An initial immediacy of effect can be observed between baseline and intervention points. Data for PEEER in

intervention are variable with an increasing trend (average = 91%, range = 78%-97%). Generalization data were 79% in baseline, while data in intervention were 69% and 90%. Baseline anticipatory set procedure implementation data are variable and have no trend (average = 17%, range = 0%-20%). An immediacy of effect can be observed between baseline and intervention. Data for anticipatory set in intervention have an increasing trend (average = 70%, range = 60%-80%). Generalization data were 20% in baseline, while data in intervention were 40% and 80%. In the maintenance condition, PEEER data were 81% and 82% (generalization), while anticipatory set data were 80% and 60% (generalization).

Leah and Jared

PEEER strategy implementation in baseline have no trend and are variable (average = 68%, range = 50%-78%). An immediacy of effect between baseline and intervention can be observed with the exception of the first data point in intervention. PEEER strategy implementation data during intervention have no trend and are variable (average = 81%, range = 23%-97%). Generalization data are 70% in baseline, while data in intervention are 94%, 77%, and 90%, respectively. Anticipatory set data in baseline have no trend (average = 15%, range = 0%-20%). An immediacy of effect from baseline to intervention is apparent. Data in intervention have no trend (average = 80%, range = 80%-80%). Generalization data are 20% in baseline, while data in intervention are 80%, 80%, and 80%. In the maintenance condition, PEEER data were 97% and 93% (generalization), while anticipatory set data were 100% and 80% (generalization).

Ruth

Data for PEEER strategy implementation in baseline have no trend and are variable (Average = 42%, range = 18%-53%). An immediacy of effect can be observed between baseline and intervention conditions. Intervention data have a decreasing trend (average = 80%, range = 76%-84%). Generalization data are 53% in baseline, while data in intervention are 82% and 79%. Data for anticipatory set implementation in baseline have no trend and are variable (average = 42%, range = 20%-60%). An immediacy of effect can be observed between baseline and intervention conditions. Intervention data have no trend and are variable (average = 88%, range = 60%-100%). Generalization data are 20% in baseline, while data in intervention are 80% and 100%. In the maintenance condition, PEEER data were 78% and 80% (generalization), while anticipatory set data were 100% and 100% (generalization).

Modified DR Components Missed

A breakdown of parent implementation of dialogic reading components can be found in Table 4. Anna missed 51 strategy implementation opportunities and implemented 50% correctly in baseline; while 26 implementation opportunities were missed and 88% implemented correctly in intervention. Candace missed 62 strategy implementation opportunities and implemented 67% correctly in baseline; while 23 implementation opportunities were missed and 88% implemented correctly. Leah and Jared missed 107 implementation opportunities and implemented 67% percent correctly in baseline; while 45 implementation opportunities were missed and 81% implemented correctly in intervention. Ruth missed 240 implementation opportunities and

implemented 41% correctly in baseline; while 38 opportunities were missed and 80% implemented correctly in intervention. The greatest number of opportunities missed across participants occurred for Expand and Repeat procedures. When comparing the number of strategies missed between baseline and intervention conditions, participants missed more strategies in baseline than in intervention.

Child Data

Aaron

Data for *Correct* responses to comprehension questions in baseline have a descending trend (average = 40%, range = 30%-50%). No immediacy of effect noted between baseline and intervention conditions. Intervention data have an ascending trend (average = 30%, range = 10%-40%). Generalization data are 50% in baseline, while data in intervention are 60% and 90%. Data for *Prompted Correct* responses to comprehension questions in baseline have an ascending trend (average = 57%, range = 50%-60%). No immediacy of effect noted between baseline and intervention conditions. Intervention data have no trend (average = 60%, range = 50%-70%). Generalization data are 50% in baseline, while data in intervention are 40% and 10%.

Benjamin

Data for *Correct* responses to comprehension questions in baseline are variable (average = 38%, range = 20%-60%). No immediacy of effect noted between baseline and intervention conditions. Intervention data are variable (average = 35%, range = 20%-60%). Generalization data are 60% in baseline, while data in intervention are 60% and 70%. Data for *Prompted Correct* responses to comprehension questions in baseline

have no trend (average = 57, range = 40%-70%). No immediacy of effect noted between baseline and intervention conditions. Intervention data are variable (average = 57%, range = 30%-80%). Generalization data are 40% in baseline, while data in intervention are 30% and 30%. In the maintenance condition, *Prompted Correct* data were 40% and 90% (generalization), while *Correct* data were 60% and 10% (generalization).

Isaac

Data for *Correct* responses to comprehension questions in baseline have no variability or trend (average = 0%, range = 0%-0%). There was an immediacy of effect between baseline and intervention with the exception of the first data point. Intervention data are variable and have no trend (average = 13%, range = 0%-30%). Generalization data are 0% in baseline, while data in intervention are 50%, 40%, and 50%. Data for *Prompted Correct* responses to comprehension questions in baseline are variable and have no trend (average = 69%, range = 20%-100%). No immediacy of effect noted between baseline and intervention conditions. Intervention data are variable (average = 65%, range = 20%-90%). Generalization data are 80% in baseline, while data in intervention are 50%, 40%, and 50%. In the maintenance condition, *Correct* data were 20% and 70% (generalization), while *Prompted Correct* data were 80% and 20% (generalization).

Solomon

Data for *Correct* responses to comprehension questions in baseline have no variability or trend (average = 2%, range = 0%-10%). An immediacy of effect is not present between baseline and intervention. Intervention data have no trend or variability

(average = 2%, range = 0%-10%). Generalization data are 0% in baseline, while data in intervention are 10%, 10%, and 50%. Data for *Prompted Correct* responses to comprehension questions in baseline are variable and have no trend (average = 9%, range = 0%-20%). An immediacy of effect noted between baseline and intervention conditions. Intervention data are stable for the first three data points and can be characterized by a descending trend for the last three data points (average = 96%, range = 80%-100%). Generalization data are 80% in baseline, while data in intervention are 90%, 90%, and 40%. In the maintenance condition, *Correct* data were 0% and 50% (generalization), while *Prompted Correct* data were 100% and 40% (generalization).

Social Validity

Participant social validity ratings can be found in Table 6. Overall, parents rated this intervention to be socially valid but reported some difficulty with child behavior and intervention procedures.

Goals

The parents stated that the goals are very important for their children. Average ratings for the importance of the goals targeted for this intervention was 4.75 with the majority of participants rating the intervention goals a five.

Outcomes

Overall, outcomes of the study were positive. Parents felt the child was able to learn the skills taught (average = 4.5), the intervention was beneficial (average = 5), and that there are noticeable changes in behavior as a result of the intervention (average =

4.75). Leah and Jared were pleased with the number of independent and prompted behaviors their child exhibited during the intervention condition. Parents also reported an increased awareness of their own behavior while reading children's books as a result of the intervention and have used the intervention procedures when reading to their other children.

Procedures

Overall, parents positively rated intervention procedures. Results of the social validity questionnaire indicated that the intervention was organized (average = 4.5), materials were organized (average = 4.75), and procedures were easy to understand (average = 4). Participants reported that their children grew tired of interventionist provided books toward the end of the intervention. Candace had difficulty with technology aspects of the intervention but also reported that the intervention would be useful for students in her classroom. Ruth had some difficulty with having her child stay seated at the beginning of the intervention but indicated improvements in the child's ability to sit on the social validity questionnaire.

Discussion

In this study, parents were remotely taught to implement modified dialogic reading strategies with their children with disabilities. Given the complexity of this multicomponent intervention and the variability of parent responding a functional relation could not be definitively determined. No change in child responses as a result of the intervention were noted, with the exception of a small change in one participant. Overall, parents deemed the intervention to be socially valid and provided helpful

feedback about the intervention. This research study extends previous work studying the impact of AAC during shared storybook reading implemented in classrooms (Finke et al., 2017; Quinn et al., 2019; Sennott, 2013; Tan, 2014), by researchers in homes (Golloher, 2018), and parents in homes (Akamoglu & Meadan, 2019) by teaching parents to implement this intervention utilizing a low-technology AAC system via telepractice.

Considering the results of this intervention in light of previous research is invaluable and can inform future practice. Some researchers have found that parents are able implement shared reading interventions with children who use AAC (Akamoglu & Meadan, 2019; Kent-Walsh et al., 2010; Na, 2015), while others have found variable parent implementation for studies conducted in naturalistic environments such as in the home (Golloher, 2018; Whalon et al., 2016). Similar to this study, Whalon and colleagues found that parents demonstrated some difficulty with implementing the Expand strategy. In contrast to this study, researchers have found increases in child behaviors such as turn taking (Kent-Walsh et al., 2010), commenting (Na, 2015), and participation (Golloher, 2018), while others have indicated that child data were more variable (Edmister & Wegner, 2015; Vogler-Elias, 2009).

Differences in the results of this study could be due to the complexity of the current intervention. Parents were coached to implement dialogic reading components, provide prompts after evaluating the child's response, and also moderate any behaviors that occurred during the book reading activity. Minimal training was provided to the parents about the provision of reinforcement. An additional focus on delivering

reinforcement may have increased the child's motivation to participate in the intervention and subsequently improve outcomes. These ideas are of practical importance for practitioners choosing the appropriate intervention for a client and researchers working to expand upon previous research.

Technological challenges during the implementation of the modified dialogic reading procedures via telepractice were evident and warrant discussion. While remote delivery was chosen to reach children with disabilities who live in locations without access to service providers, because it may potentially save travel time, and could result in a reduction in the amount money spent on fuel, (American Speech-Language Hearing Association Telepractice, n.d.; Reese et al., 2013; Sutherland et al., 2018; Wales et al., 2017) parents struggled to upload videos due to lack of technological knowledge and decreased home upload speeds (Fawns, 2019; Lerman et al., 2020; Scheerder, et al., 2019). Researchers and manufacturers could invest time to educate users about the devices used or provide video tutorials. Environmental modifications such as decreasing the number of people in the household using the internet during telepractice sessions could also be suggested (Lerman, 2020). Greater attention to technological problems and the ingenuity to come up with innovative solutions are warranted by all stakeholders.

Limitations

Limitations to this study exist. First, the interventionist inadvertently provided prompts to Stephen during the initial book reading session conducted in the home by the first author while Julia was watching. Parent exposure to parts of the prompting procedure prior to intervention training could have impacted parent implementation data.

Second, there were no training fidelity data collected in baseline for one parent. Third, books were preselected without consideration for child and parent preferences. Fourth, masked raters were not used for the collection of IOA data which could be a source of observer bias for this study (Ledford & Gast, 2018). Fifth, it should be noted that the interventionist had a prior coaching history with one dyad which could have impacted intervention implementation and the generalizability of the outcome. Finally, the Evaluate portion of this modified dialogic reading intervention was not measured in this study and it is an integral part of the dialogic reading strategy. In the spirit of the evolution of dialogic reading procedures (Arnold et al., 1994; Burns et al., 1999; Whitehurst et al., 1988, 1994), we considered this intervention to be another variation of the strategy suitable for individuals with developmental disabilities.

Future Research

Future research could incorporate high-technology devices when answering questions as an additional option for communication. Additional studies could also use books targeting social skills because storybook reading provides a natural context for discussion. While cost effectiveness and feasibility have to be taken into consideration (Ledford & Gast, 2018), masked raters can be used in future studies. Researchers found that the greatest number of missed implementation opportunities occurred for the Expand and Repeat portions of the intervention, while parents were able to implement the Prompt and Extend portions of the intervention. Future studies could further explore

these intervention components. Finally, if critical to the effectiveness of dialogic reading, future studies can consider using an "Evaluate" definition such as the one from a study by Towson in which researchers define Evaluation as "a verbal affirmation of the child's response" or one from a study by Blom-Hoffman where it is defined as "Parent evaluates what the child says by praising the child, repeating what the child says, or gently correcting the child's answer" (Blom-Hoffman et al., 2007; Towson et al., 2019).

Conclusion

In conclusion, while some of the child participants demonstrated improvements in unprompted behaviors, the secondary dependent variable, this change was not consistent across all behaviors. Tentative evidence that parents can learn to implement some components of modified dialogic reading when trained and coached via telepractice was found as a result of this modified dialogic reading intervention. Thus, the variability of the data make it difficult to definitely say that changes in parent outcome data had a positive impact on the children.

Figure 1 Parent Percentage of Strategies Used Reprinted from (Pierson et al., 2021)

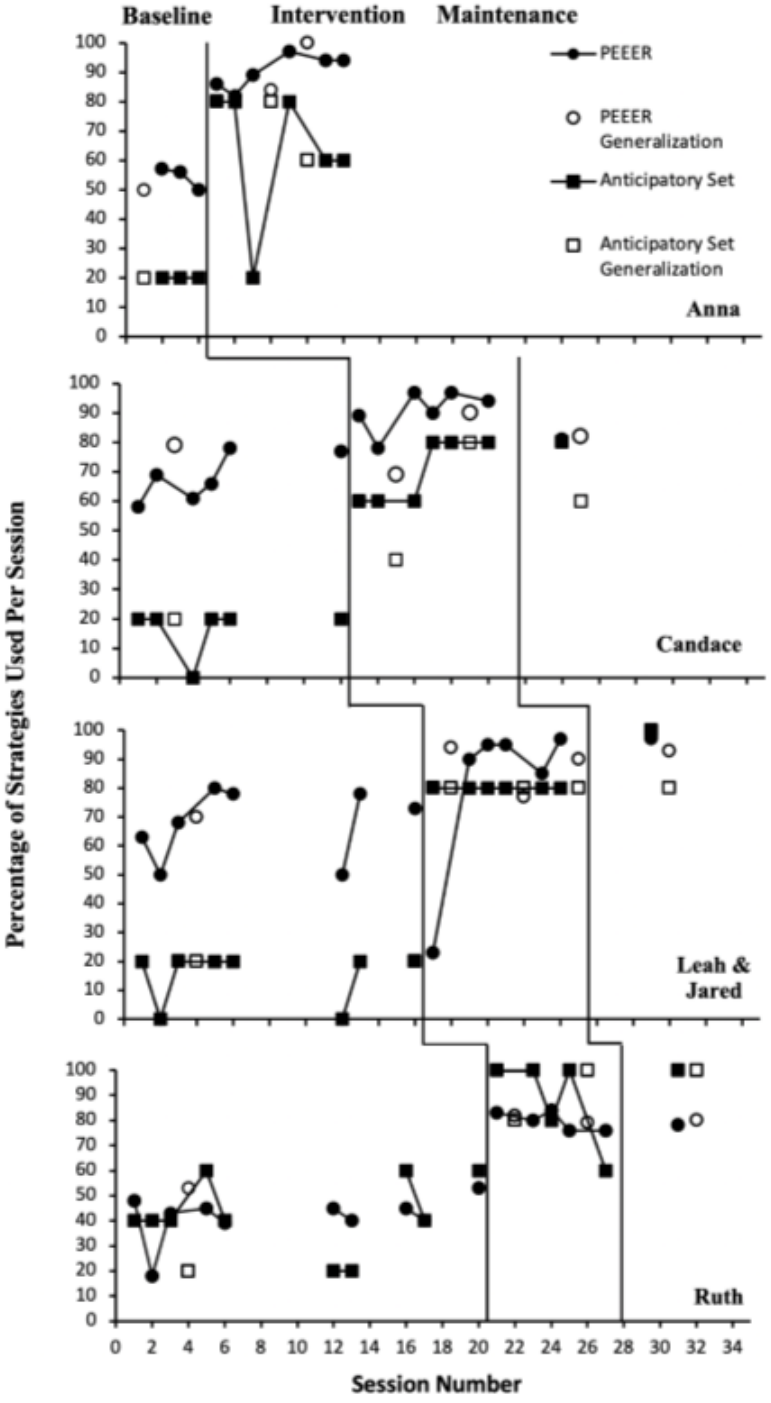

Figure 2 Child Percentage of Comprehension Questions Answered Reprinted from (Pierson et al., 2021)

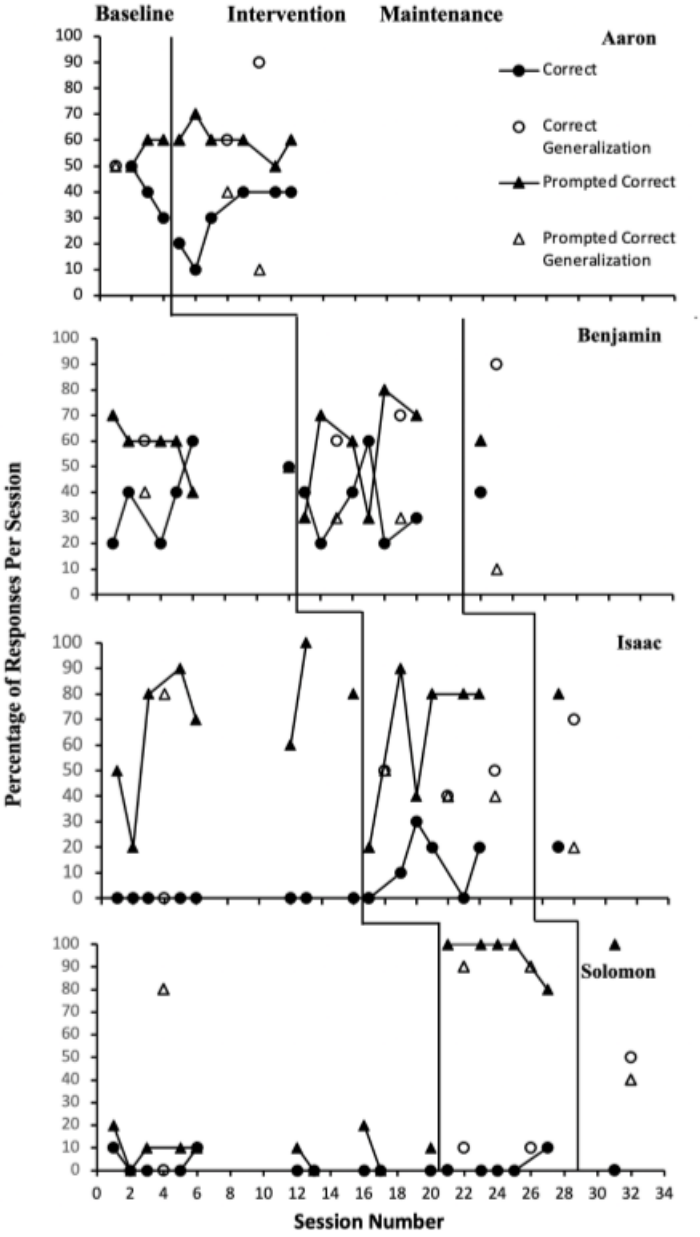

Table 1 Parent Demographic Information Reprinted from (Pierson et al., 2021)

Participant	Occupation	Education Level	Previous Experience	Room/Dimensions*
Anna	Homemaker	Some College	Trainings	Dining/ -
Candace	Teacher	BS	Trainings & RE	Living/14'x 14'
Leah/Jared	COTA/Engineer	Associates/BS	BT/None	Bedroom/10'x12'
Ruth	Teacher	MS	Trainings	Family Office/13'x15.5'

Note. Dash (-) indicates that data were not collected. BT=Behavior Technician, BS=Bachelor of Science, MS=Master of Science, COTA=Certified Occupational Therapist, RE=Research Experience, Trainings=Reported trainings were parent trainings for Applied Behavior Analysis (Anna) and teacher trainings as part of occupation (Candace and Ruth). *=All settings in place familiar to child and dimensions are approximate.

Table 2 Child Demographic Information Reprinted from (Pierson et al., 2021)

Participant	PPVT-5 SS	PPVT-5 Interpretation	VABS-3 SS*	Communication Mode	Services Received
Aaron	79	Below expected	121	Verbal; Sentences	SPED, ST, OT
Benjamin	79	Below expected	80	Verbal; Sentences	SPED, ST, OT
Isaac	67	Well below expected	40	Sign, Gestures, AAC	ST, ABA
Solomon	56	Well below expected	50	Gestures, AAC	SPED, APE, OT, ST, PT

Note. SS=Standard Score, Communication Mode=Child communication mode prior to the study, SPED=Special Education, APE=Adapted Physical Education, OT=Occupational Therapy, ST= speech-language therapy, PT=Physical Therapy, PPVT-5= Peabody Picture Vocabulary Test-Fifth Edition, VABS-3= Vineland Adaptive Behavior Scales-3, VABS-3 SS=Adaptive Behavior Composite standard score, ABA=Applied Behavior Analysis, AAC=Augmentative and Alternative Communication.

*Mean = 100, Standard Deviation = 15

Table 3 Child Comprehension Question Answer Descriptions Reprinted from (Pierson et al., 2021)

Behavior	Description
Correct	Child independent correct oral answer using words or word approximations, book picture point, sign, or answer choice picture point within 10 seconds.
Prompted Correct	Child provides incorrect response. Parent provides system of least prompts. Child provides oral answer using words or word approximations, book picture point, sign, or answer choice picture point within 10 seconds.
Prompted Incorrect	Child provides an incorrect response. Parent provides system of least prompts. Child provides an incorrect response within 10 seconds.
Incorrect	Child provides incorrect response to a question within 10 seconds. Parent does not provide system of least prompts.

Table 4 Number of Modified Dialogic Reading Component Opportunities Missed Per Condition Reprinted from (Pierson et al., 2021)

	Number of Modified Dialogic Reading Components						
		Baseline		Intervention		Maintenance	
Parent	Baseline	Generalization	Intervention	Generalization	Maintenance	Generalization	Total
Anna	n=3	n=1	n=6	n=2	-	-	
Prompt	0 [100]	0 [100]	3 [95]	0 [100]	-	-	3
Extend	3 [85]	0 [100]	3 [93]	0 [100]	-	-	6
Expand	27 [10]	10 [0]	9 [84]	3 [85]	-	-	49
Repeat	21 [0]	3 [0]	11 [80]	2 [82]	-	-	37
Total	51 [50]	13 [50]	26 [88]	5 [91]			95
Candace	n=6	n=1	n=6	n=2	n=1	n=1	
Prompt	0 [100]	0 [100]	0 [100]	0 [100]	0 [100]	0 [100]	0
Extend	0 [100]	0 [100]	1 [97]	0 [100]	0 [100]	1 [0]	2
Expand	28 [52]	3 [70]	6 [90]	1 [94]	0 [100]	1 [89)	39
Repeat	34 [6]	3 [25]	16 [61]	6 [45]	6 [0]	1 [0]	66
Total	62 [67]	6 [79]	23 [88]	7 [88]	6 [81]	3 [86]	107
Leah & Jared	n=8	n=1	n=6	n=3	n=1	n=1	
Prompt	4 [95]	0 [100]	7 [83]	0 [100]	0 [100]	0 [100]	11
Extend	6 [92]	0 [100]	7 [87]	2 [88]	0 [100]	0 [100]	15
Expand	32 [60]	2 [78]	11 [82]	3 [90]	0 [100]	0 [100]	48
Repeat	65 [20]	10 [0]	20 [67]	6 [71]	1 [89]	2 [50]	104
Total	107 [67]	12 [69]	45 [81]	11 [88]	1 [97]	2 [93]	178
Ruth	n=10	n=1	n=5	n=2	n=1	n=1	
Prompt	14 [90]	0 [100]	0 [100]	0 [100]	0 [100]	0 [100]	14
Extend	31 [69]	2 [80]	0 [100]	0 [100]	0 [100]	0 [100]	33
Expand	96 [3]	7 [30]	1 [98]	1 [95]	0 [100]	1 [86]	106
Repeat	99 [0]	10 [0]	37 [23]	14 [22]	9 [0]	5 [0]	174
Total	240 [41]	19 [53]	38 [80]	15 [80]	9 [55]	6 [74]	327

Note. Dash (-) indicates that data were not collected. n=number of sessions, [ ]=percentage implemented correctly.

Table 5 Procedural Integrity, Training Fidelity, and Interobserver Agreement Reprinted from (Pierson et al., 2021)

Parent Name	PI	TF BL	TF IV	Child	PEEER	Anticipatory Set
Anna	100% (100%–100%)	-	100% (100%–100%)	90% (80% –100%)	90% (87%–94%)	93% (80%–100%)
Candace	100% (100%–100%)	100% (100%–100%)	89% (89%–89%)	85% (70%–100%)	89% (80%–100%)	97% (80%–100%)
Leah/Jared	96% (89%–100%)	100% (100%–100%)	75% (75%–75%)	90% (70%–100%)	92% (83%–100%)	89% (60%–100%)
Ruth	100% (100%–100%)	100% (100%–100%)	100% (100%–100%)	92% (80%–100%)	93% (88%–100%)	87% (40%–100%)

Note. Dash (-) indicates that data were not collected. The mean is followed by the range in parenthesis. PI=Procedural Integrity, TF BL=Training Fidelity Baseline, TL IV=Training Fidelity Intervention.

Table 6 Participant Social Validity Ratings Reprinted from (Pierson et al., 2021)

	Anna	Candace	Leah & Jared	Ruth	Average
How would you rate the overall organization of the procedures for this research project?	4	5	4	5	4.5
How would you rate the organization of the materials used for this intervention?	4	5	5	5	4.75
How would you rate the ease of use of the children's book used for this intervention?	4	5	4	5	4.5
Do you believe you could use the materials and instructional methods for other children living in your home?	4	5	4	5	4.5
Do you feel that the procedures used for the intervention are easy to understand?	3	5	4	4	4
Is it difficult to use the intervention for your child?	4	1	4	2	2.75
Did your child's challenging behaviors make it difficult to use the storybook reading lessons?	2	1	2	3	2
Was your child able to learn the skills you were teaching?	4	5	4	5	4.5
Did the intervention interfere with your typical daily activities?	3	1	3	5	3
Do you feel that the intervention was beneficial to your child?	5	5	5	5	5
Did your child enjoy the book reading lessons?	4	5	4	4	4.25
Did your child feel successful during the intervention?	5	5	4	4	4.5
Do you think the skills that your child is learning are important skills?	5	5	4	5	4.75
Do you feel that there are noticeable changes in behavior as a result of this intervention?	5	5	4	5	4.75
Are you happy with the procedures and results of this study?	4	5	4	5	4.5
Do you think the intervention was efficient and cost effective?	5	5	5	5	5

Note. (1) Strongly disagree, (2) Disagree, (3) Neither agree nor disagree, (4) Agree, (5) Strongly agree.

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CHAPTER III

STORYBOOKS USED AS INTERVENTION ANCHORS FOR CHILDREN WITH DEVELOPMENTAL DISABILITIES: A SYSTEMATIC REVIEW AND META-ANALYSIS

Reading illustrated books to children is a part of daily routines in many homes. Shared reading refers to an adult and child interacting with a book by talking about pictures, answering questions related to the story, or discussing different vocabulary words (Boyle et al., 2019). Language skills are enhanced because opportunities to expand language, ask higher level thinking questions, and encourage multimodal communication present themselves while reading together (U.S. Department of Education, Institute of Education Sciences, What Works Clearinghouse, 2015). Benefits of shared reading include exposure to different vocabulary words than typically heard verbally (Massaro 2015), increases in theory of mind abilities (Kidd & Castano, 2013), and increases in bonding time between the parent and child likely leading to better overall health and well-being (Winston & Chicot, 2016). In addition, the integration of storybooks into the practice of speech-language pathology and education is an integral part of the learning process (Anderson, Hiebert, Scott, Wilkinson, & The Commission on Reading, 1985). Research also supports the use of storybooks as a context for learning in children who are typically developing (Horst, Parsons, & Bryan, 2011).

Individuals with developmental disabilities such as autism spectrum disorder (ASD), intellectual disabilities (ID), or physical disabilities often present with significant communication and language deficits, and stakeholders often look for ways to work on foundational skills in naturalistic contexts (Schreibman et al., 2015). Interactions between individuals with disabilities and their communication partners may require strategies to repair communication breakdowns given the complexity of the child's communication system and overall dearth of language skills (Shire & Jones, 2014). Interventions to remediate these deficits may incorporate augmentative and alternative communication systems (AAC) such as communication books, printed picture answer choices, or answer choice grids on an electronic device. Treatment goals can relate to input from the family (Bedrosian, 1999; Gevarter & Zamora, 2018), child strengths, and the needs of the child (American Speech-Language Hearing Association Augmentative and Alternative Communication, n.d.).

Storybooks are an open-ended medium that are easily integrated into therapy sessions and natural activities for individuals working on a wide range of speech and language targets, such as speech sounds, comprehension, vocabulary, or fluency strategies (Sparapani et al., 2020). Speech-language pathologists in school settings conduct group and individual speech services (ASHA, 1991). Storybooks read in group settings can help students learn vocabulary words when implicit and explicit methods of instruction are used (Brandel, 2020). Definitions can be explicitly taught by verbally saying the definition and then recalling the definition. Clinicians can implicitly teach definitions by providing expansions that include the target word (Brandel,

2020). Pictures in children's books can also provide helpful clues about stories (Reid, 2020), and active participation can be promoted during reading sessions by calling attention to different aspects of the pictures in text (Stortz et al., 2010). Picture book colors can signal character mood, and text size can add emphasis (Martinez et al., 2020; Nikolajeva & Scott, 2000). At a more basic level, clinicians can use pictures to work on adjectives (Hayes & Ahrens, 1988), teach students to look at pictures to aid in comprehension, or help children develop the ability to tell stories (Robertson, 2017).

While a number of studies have analyzed literacy interventions targeting a variety of skills, none examined the effects of interventions using storybooks as a tool for school-age children who use augmentative and alternative communication to date. Reviews by Mandak, Light and Boyle (2018) and Roberts et al. (2013) focused, in part, on learning to read words, but neither conducted a comprehensive review of study quality. Browder et al. (2006) and Hudson & Test (2011) conducted reviewed general reading skills for individuals with disabilities. Finally, a review by Boyle, McNaughton, & Chapin (2019) included studies that implemented shared reading interventions for those with autism spectrum disorder (ASD), but did not use AAC as an inclusion criteria.

Literacy interventions for individuals with physical disabilities that use AAC is an area of work in which few studies have been conducted (Machalicek et al., 2010)). Machalicek and colleagues found that most of the studies included in their review

examined emergent literacy skills and did not use an experimental design. In addition, the authors did not complete a forward search, nor was gray literature included. Thus, the current review seeks to expand on the previous literature and incorporate these elements.

Characteristics of moderators used in the previous literature vary. Mandak, Light, and Boyle (2018) examined instructional methods used to teach word reading including phonological and sight word methods. Reviews by Roberts et al. (2013) and Browder et al. (2006) examined components of the NRP Big 5 the included study targeted. In addition, Roberts and colleagues reviewed the type of text used and the content of the text. Hudson and Test took a broader look at all of the variables.

To our knowledge, no authors have synthesized literature related to storybook interventions for individuals with developmental disabilities and complex communication needs while using AAC. Nor have they assessed potential moderators such as the type of book, AAC device, use of frontloading, or use of time delay procedures. The aims of the present review were to address these deficits. The research questions for this study include:

Research Question 1: What is the magnitude of effect of storybooks used as intervention tools on the communication outcomes of school-age children with ASD or ID who use AAC?

Research Question 2: What is the magnitude of effect of storybooks used as intervention tools on the communication outcomes of school-age children with physical disabilities?

Research Question 3: How do study characteristics including front-loading, book type, and AAC type moderate the efficacy of shared book reading interventions?

Research Question 4: What are the descriptive features of storybook reading interventions for individuals with ASD, ID, and Physical Disabilities?

Method

Search Procedures

Literature Search

Researchers conducted the initial search in October of 2017 and updates in August of 2018 and February of 2020. Dates were not limited and gray literature including theses and dissertations were included. Categories for search terms related to reading, AAC, and disabilities. The authors used keywords of included studies and the thesaurus to create a comprehensive list of search terms. Reading search terms related to children's books, books, shared reading, and storybooks. AAC terms related to augmentative and alternative communication and device names. Terms for disabilities related to disability names such as ASD, ID, and Down syndrome. Electronic databases searched were ERIC, Academic Search Ultimate (Ebsco), PsycINFO (Ebsco), Linguistics and Language Behavior Abstracts (LLBA), and Proquest Dissertations and Theses Global. See Table 7 for Search Terms and Databases. Authors conducted an

ancestral search of reference lists of included articles and forward search in Google Scholar of articles that cited included studies following inclusion procedures described below.

Inclusion and Exclusion Criteria

Inclusion criteria used during the title and abstract stage were applied in the following order: (a) articles written in English, (b) inclusion of at least one individual with a disability (e.g., ASD, Pervasive Developmental Disorder-Not Otherwise Specified, Rett's Syndrome, Cerebral Palsy) OR who used an augmentative and alternative communication device (e.g., Picture Exchange Communication System (PECS), Dynavox, communication book, presymbolic and early symbolic communication skills), (c) use of storybooks as intervention tools (i.e. words and/or pictures in storybooks are used to target learner objectives), (d) use of a single-case research design, and (e) inclusion of dependent variables measuring expressive language skills. Articles were included for the full-text review if any of the above were not clearly stated in the title/abstract. The search was organized using Rayyan, a systematic review software (Hammady et al., 2016).

Researchers applied full-text inclusion criteria to each of the remaining studies in the following order: (a) single-case experimental design (i.e., reversal/withdrawal, multi-element, alternating treatment design, repeated acquisition design, changing criterion design, multi-element, complex reversal, multiple probe design, multiple-baseline design); (b) participants ages 3-22; (c) inclusion of at least one participant with a

disability or suspected disability such as ASD, Pervasive Developmental Disorder-Not Otherwise Specified, Rett's Syndrome, Cerebral Palsy, or intellectual disability; (d) at least one participant used an augmentative and alternative communication device (e.g., aided systems, unaided systems, manual sign language, high-technology devices, low-technology devices, speech generating devices) during the intervention; (e) storybooks were used for the intervention (i.e., paperback books, adapted books, or multimedia books); (f) dependent variable related to child expressive language skills (e.g., making choices, yes/no answers, taking conversational turns, rate of communicative turns, answering questions, or telling stories; not including pre-literacy skills, such as turning book pages, identifying the front cover of the book, identifying letter sounds); (g) published in a peer-reviewed journal or is a dissertation.

Review of Design Quality

Researchers reviewed design quality standard criteria for each figure and dependent variable. Design standards were adapted from WWC (2016, 2018). Schlosser et al. (2007) recommended the use of similar quality review components, including the inclusion of only certain design types and the use of inter-rater agreement. Also of importance is study implementation. The current review used ratings of meets standards (i.e., 2), meets standards with reservations (i.e., 1), and does not meet standards (i.e., 0) for each criteria. Articles were considered to meet the basic standards if criteria a-d were given a score of "2," "1," or "0." Criteria included: (a) independent variable manipulation, (b) number of interobserver agreement data points gathered, (c) interobserver agreement data percentages calculated, (d) attempts to demonstrate an

effect, and (e) number of data points in each phase. Researchers separately analyzed studies not meeting the criteria for basic standards (i.e., criteria a-d) from those that met the basic quality standards with reservations. See Table 8 for additional details regarding specific basic Design Quality Criteria and Ratings.

Study Selection

Three doctoral students in special education reviewed titles and abstracts, full-texts, and articles for design quality. The first author trained raters to complete inter-rater reliability with a small number of articles at each stage of review until there was 80% agreement.

Variable Coding

Three undergraduate students in the special education program completed variable coding. A small number of articles were used for training purposes and independent coding ensued after each rater reached at least 80% reliability. Participant characteristics coded included (a) age, (b) participant reported gender (i.e., male, female, not reported), (c) participants who are English-language learners or report of second language in background, and (d) child services received (e.g., physical therapy, occupational therapy, speech-language pathology, adaptive physical education). We also recorded the dependent variable that targeted expressive language skills. Implementation factors included (a) intervention setting (i.e. other setting outside of home, classroom, clinic, other room in school), (b) implementation format (i.e., one-to-one or group), (c) intervention dosage in minutes (e.g., calculate an estimation of the

total number of minutes of instruction per participant), and (d) implementer years' experience (i.e., 0-3, 4-7, 8-11, 12-16, 17-20). Finally, we also reviewed publication type (i.e., peer-reviewed journal or dissertation). Moderator coding variables included: (a) book type (i.e., paperback, adapted paperback, book on an application, or combination if the study used more than one book type), (b) AAC type (i.e., low technology, mid- to high-technology, or combination if participants in the study used more than one type of technology for intervention), (c) use of time delay (i.e., Did researchers wait before providing prompts to allow the child answer independently?), and (d) front loading (e.g., prior to the story review title, ask foreshadowing questions, talk about the pictures on the front of the book).

Data Extraction

Data from included articles were extracted using Engauge Digitizer, an online software program (Mitchell, Muftakhidinov, Winchen, et al., n.d.) that has primarily been used to analyze data in medicine (Gao, Gong, & Wang, 2018; Shi, Chen, & Wang, 2019; Wang, Xin, Lin, Wang, Liu, & Liu, 2018). Other reviews have used similar procedures (Lequia, Wilkerson, Kim, & Lyons, 2014; Losinski, Cuenca-Carlino, Zablocki, & Teagarden, 2014).

Data Analysis

Effect Size

The authors used Tau-*U*, a non-overlap measurement, to measure the effect-sizes for this meta-analysis. An examination of the non-overlap between baseline and

intervention compared to the intervention trend, in addition to attention to trend make this a desirable method. In addition, Tau-*U* allows researchers to control for baseline trend and use all data (Parker, Vannest, Davis, & Sauber, 2011). Tau-*U* values range from -1 to 1. Effect size ratings were based on those of Liao et al. (2020) and included ranks of very large (90th percentile or above), large (75th to 89th percentile), moderate (25th to 74th percentile), small (10th to 24th percentile), and very small (9th percentile and below).

Statistical Analysis

Researchers used a random-effects model, which produces an estimation of the average distribution of all effects (Borenstein, et al., 2009). The random-effects model is an ideal choice because the authors considered included studies heterogeneous in terms of their study design, dependent variables, and intervention characteristics. This study used the statistical software *R* with the *metafor* package for data analysis and the *metaviz* package to create the funnel plots (R Development Core Team, 2019; Viechtbauer, 2010). Furthermore, this meta-analysis also reported Q_w (error that is found within studies) (Borenstein, et al., 2009), τ/τ^2 (variance between effect sizes), and I^2 (proportion of variance representing the actual amount of difference in effect sizes) (Borenstein, et al., 2009). In addition to the random effects model, a sensitivity analysis helped determine if results such as standard errors or means would be different if one or more studies were missing. Funnel plots and the Trim-and-Fill method measured publication bias. Last, a mixed methods meta-regression examined study moderators including frontloading, book type (adapted vs. paperback), and AAC type (Cooper, 2015).

Researchers analyzed manuscripts including participants who had ASD, ID, or a combination of both together given the similarities between the two etiologies, while researchers analyzed studies including individuals with physical disabilities separately (Thurm et al., 2019).

Inter-rater Reliability

At least two undergraduate or graduate students in special education completed inter-rater reliability for all stages of this systematic review and meta-analysis. See Table 9 for Inter-rater Reliability. Disagreements were resolved via discussion. Design quality review percentages were likely low due to the reporting of aspects of design quality in the text and the detailed nature of the design quality standards. The agreement percentage for the types of services received was also likely low due to reporting methods. Finally, the agreement for implementation format was low likely due to the ambiguous and varied language used to talk about the format of the intervention. Three doctoral students in special education extracted data from the figures, and two raters completed reliability for 100% of the articles. A disagreement was counted if the difference in scores between the two raters was 1% or greater (Boyle et al., 2013; Drevon et al., 2017; Rakap et al., 2016). Data were extracted a second time for data points in disagreement, and an agreement was reached through discussion.

Results

This review of the literature synthesized single-case experimental design studies that conducted storybook reading interventions with individuals who had ASD, ID and

physical disabilities. Overall, searches retrieved 997 articles. The first author removed duplicates and 930 unique articles remained. Following title/abstract review, 267 articles remained for full-text consideration and researchers applied design quality criteria to the 36 articles that met full-text criteria (i.e., those with participants that had ASD/ID and those with physical disabilities). Twenty-five documents met the standards with reservations, and 11 documents did not meet standards. Of the 36 articles reviewed for design quality, a total of 21 studies met basic quality standards and were included in the ASD/ID group (72 participants; male = 45, female = 20, and gender not reported = 8); and 10 studies that did not meet basic quality criteria were included in the ASD/ID DNM group (29 participants; male = 25, female = 4). Of the 36 articles reviewed for design quality, 9 studies met basic quality standards and were included in the physical disability group (18 participants; male = 8, female = 6, gender not reported = 9); and four studies that did not meet criteria were included in the physical disability DNM group (5 participants; male = 4, female = 0).

Descriptive Information

Descriptive information for the ASD/ID group of studies that met quality standards and those that did not meet quality standards. See Table 10 for Descriptive Information ASDID. Studies included individuals ages 3-5;11 (n (number) = 14), 6-10;11 (n = 16), and 11-13;11 (n = 6). Eight studies included individuals that were English language learners and all studies with the exception of two reported that participants received at least one type of special education service. The dependent variable targeted in the most studies was comprehension (n = 10) followed by

engagement (n = 5). The largest number of studies took place in a classroom (n = 17) and reported an adult to person with a disability ratio of one-to-one for intervention (n = 22). The number of total minutes for intervention could be calculated for seven studies with a mean of approximately 573 minutes (range = 65 - 1368). Most of the studies were peer reviewed and reported that implementers had some level of prior experience working with individuals who have disabilities.

Descriptive information for studies including individuals with physical disabilities that met quality criteria and those that did not meet quality criteria. See Table 11 for Descriptive Information Physical Disabilities. Studies included individuals ages 3-5;11 (n = 2), 6-10;11 (n = 9), 11-13;11 (n = 3), and 14 and up (n = 1). One study reported inclusion of an English Language Learner and all but two studies indicated participants received some type of special education service. The dependent variable targeted in the most studies was comprehension (n = 6). Most of the studies took place in the classroom (n = 8) using a one-to-one teaching format. The number of total minutes for intervention could be calculated for five studies with a mean of approximately 540 minutes (range = 420 - 660). Most of the implementers had some type of experience working with individuals who have disabilities and publication types were mostly peer-reviewed.

Effect Sizes

First, we calculated effect size measurements for all of the studies by separating baseline and intervention data in each study and then combining the data in each study to

calculate one effect size. Tau-*U* values that were greater than one were given a value of one when conducting data analysis. The authors calculated effect sizes for the ASD/ID group and physical disabilities group separately. Tau-*U* effect sizes for studies in the ASD/ID group that met quality standards with reservations (Tau-*U* = .7936, CI [.6359, .9514], *p* = <.0001) compared to the ASD/ID DNM group that did not meet quality standards (Tau-*U* = .7743, CI [.5064, 1.0422], *p* = <.0001) were similar. Effect sizes for the Physical Disability group that met quality standards with reservations (Tau-*U* = .7168, CI [.4489, .9847], *p* = <.0001) compared to the Physical Disability DNM group that did not meet quality standards with reservations (Tau-*U* = .8668, CI [.4180, 1.3157], *p* = <.0002) revealed no differences. See Table 12 for ASDID Moderator Analyses and Table 13 for Physical Disability Moderator Analyses. Due to the lack of heterogeneity between ASD/ID and ASD/ID DNM in addition to Physical Disability and Physical Disability DNM, researchers combined study effect sizes for ASD/ID with ASD/ID DNM and study effect sizes for Physical Disability with Physical Disability DNM. See forest plots for ASD/ID studies (i.e., Figure 3 = Overall Forest Plot ASD/ID Studies, Figure 4 = Forest Plot ASD/ID Meets with Reservations and Does Not Meet Standards) and Physical Disability (i.e., Figure 5 = Overall Forest Plot Physical Disability Studies, Figure 6 = Forest Plot Physical Disability Meets with Reservations and Does Not Meet Standards). The remained of the Results section reports combined results for each disability type.

ASD/ID

ASD/ID effect size ranges derived for each study were variable and ranged from Tau-*U* = 0.40 to Tau-*U* = 1 (See Table 12). The omnibus effect size for all ASD/ID studies was .7887 with CI .6527 to .9246 and p = <.0001, which indicates a large effect. In addition, $tau^2 \approx 0$ paired with $I^2 = 0.00\%$ indicates the observed variance is very small and cannot be explained by a moderator. See Figure 7 for the ASD/ID Funnel Plot Right Side and Figure 8 for the ASD/ID Funnel Plot Left Side. While tau^2 and I^2 values indicated that there were little differences in effect sizes, researchers still chose to conduct a moderator analysis for studies including individuals with ASD/ID.

Physical Disabilities

Effect sizes for the physical disability group ranged from Tau-*U* = 0.20 to Tau-*U* = 1 (See Table 13). The omnibus effect size for all studies including individuals with physical disabilities is Tau-*U* = .7562 with CI .5262 to .9862 and p = <.0001, which indicates a large effect. In addition, $tau^2 \approx 0$ paired with $I^2 = 0.00\%$ means the observed variance is very small and cannot be explained by the moderators. See Figure 9 for the Physical Disability Funnel Plot Right Side and Figure 10 for the Physical Disability Funnel Plot Left Side. While tau^2 and I^2 values indicated that there were little differences in effect sizes, researchers still chose to conduct a moderator analysis for studies including individuals with physical disabilities.

Moderator Analysis

Effect of Book Type

ASD/ID

Moderator variables included book type, AAC type, wait time, and frontloading for all studies. Most of the ASD/ID studies used an adapted paperback book (n = 15). Adapted paperback books (K = 15) had 72 A-B Phase Comparisons, paperback books (K = 13) had 81 A-B Phase Comparisons, books on an application (K = 2) had 5 A-B Phase Comparisons, and Combination (K = 1) had 4 A-B Phase Comparisons. Tau-U values ranged from .6627 to .9524. Out of all of moderator effects listed in Table 12, books on an application was the lowest Tau-U effect size value and a combination of book types was the highest Tau-U effect size value. Effects ranged from moderate to very large. The omnibus Q_w for this moderator was 6.1138 where p = 1.0000, indicating that all of the differences between the studies can be explained by the predictors and there is not a statistically significant difference between book types used for the intervention.

Physical Disability

Most of the Physical Disability studies used an adapted paperback book (n = 8). Adapted paperback books (K = 8) had 22 A-B Phase Comparisons, paperback books (K = 4) had 28 A-B Phase Comparisons, and Combination (K = 1) had two A-B Phase Comparisons (See Table 13). Tau-U values ranged from .4883 to .9829, which indicated moderate to very large effect sizes. Out of all the moderator values listed in Table 13, paperback books was the lowest Tau-U effect size and a combination of book types was

the highest Tau-*U* effect size. Effects ranged from moderate to very large. The omnibus Q_w for book type was 3.4957 where $p = .9672$, indicating that all of the differences between the studies can be explained by the predictors and there is not a statistically significant difference between book types.

Effect of Frontloading

ASD/ID

Approximately 50% of the studies included in the ASD/ID group used Frontloading as a part of the intervention. Studies coded "Yes" ($K = 14$) had 57 A-B Phase Comparisons, whereas studies coded "No" ($K = 17$) had 105 A-B Phase Comparisons (See Table 12 for ASDID Moderator Analyses). Tau-*U* values ranged from .7724 (studies that did not utilize frontloading) to .8102 (studies that did utilize frontloading), indicating all had large effect sizes. The omnibus Q_w for Frontloading was 6.4231 where $p = 1.0000$, indicating that all of the differences between the studies can be explained by the predictors and there is not a statistically significant difference between studies that included frontloading as a strategy and those that did not.

Physical Disability

Approximately 50% of the studies included in the Physical Disability group used Frontloading as a part of the intervention. Studies coded "Yes" ($K = 7$) had 18 A-B Phase Comparisons, whereas studies coded "No" ($K = 6$) had 34 A-B Phase Comparisons (See Table 13 for Physical Disability Moderator Effects). Tau-*U* values ranged from .7475 to .7638, indicating moderate to large effects. The omnibus Q_w for

frontloading was 6.3168 where p = .8514, indicating that all of the differences between the studies can be explained by the predictors and there is not a statistically significant difference between studies that used frontloading as a strategy and those that did not.

Effect of AAC type

ASD/ID

In terms of AAC type for studies included in the ASD/ID group, low technology devices were used for the most of the studies. Studies using low technology (K = 14) had 78 A-B Phase Comparisons, high technology (K = 10) had 50 A-B Phase Comparisons, and a combination of device types (K = 7) had 34 A-B Phase Comparisons (See Table 12 for ASDID Moderator Analyses). Tau-U values ranged from .7366 to .9181, indicating moderate to very large effects. The omnibus Q_w for frontloading was 5.5676 where p = 1.0000, indicating that all of the differences between the studies can be explained by the predictors and that there is not a statistically significant difference between the types of AAC used in the studies.

Physical Disability

In regard to the Physical Disability group of studies, low and high technology devices were used the majority of the time for the intervention. Studies low technology (K = 6) had 29 A-B Phase Comparisons, studies coded "No" (K = 2) had 4 A-B Phase Comparisons, and studies using a combination of AAC types (K = 5) had 19 A-B Phase Comparisons (See Table 13 for Physical Disability Moderator Effects). Tau-U values ranged from .5569 to .9609, indicating moderate to large effects. The omnibus Q_w for

frontloading was 3.9974 where $p = .9475$, indicating that all of the differences between the studies can be explained by the predictors and that there is not a statistically significant difference between the type of AAC that was used in studies.

Publication Bias

A visual analysis of the Funnel Plots with Trim-and-Fill for the Physical Disability and ASD/ID studies revealed asymmetry with more studies closer to the mean on the right side than the left side. Open circles indicate possible studies that were not included in the search. These results show that there was some bias in reporting outcomes in this study (See Figures 7, 8, 9, and 10 for more information).

Sensitivity Analysis

In regard to both the ASD/ID and physical disability sets of studies, results of the Influence method indicate that leaving particular studies out does not influence the outcomes. Likewise, results of the Leave-1-Out Method also revealed no significant changes in the data because of the exclusion of a particular study.

Discussion

This meta-analysis synthesized studies related to storybook reading interventions for individuals with ASD, ID, or both and a separate analysis took place for those with physical disabilities. Descriptive information across studies and disabilities revealed most of the participants were ages 6-10;11. English language learners as participants were not widely reported in the studies and comprehension was the dependent variable

widely used. The intervention took place in a one-to-one format and in the classrooms. The omnibus effect size for ASD/ID studies revealed that the storybook reading intervention had a moderate effect on communication outcomes and the omnibus effect size for physical disability studies revealed that the storybook reading intervention had a large effect on communication outcomes. Factor level effects were statistically significant across moderators with the exception of the use of high-technology devices for individuals with physical disabilities. There were no statistically significantly different effects between any of the moderators in a given category. Use of wait time, expectant delay, or time delay was not included for analysis because it was included in all of the studies. Researchers should interpret the results of this study with caution given the number of included studies in each disability group.

Moderator Analysis

First, a comparison of adapted paperback books, paperback books, books on an application, and studies that used a combination of book types in intervention found no statistically significant differences in true effect sizes. Thus, no differences in results are likely if either paperback or adapted paperback books are used when targeting expressive communication skills. This is the first study to evaluate the impact of the type of book used on communication outcomes. Book elements adapted were similar across studies. Researchers used repeated storylines or summaries to draw attention to the main idea of the story (Browder et al., 2011; Kemper, 2012; Mims, 2009; Spooner et al., 2009; Spooner et al., 2014), attached picture symbols to the book pages to draw attention to vocabulary words being taught in the intervention (Golloher, 2018; Kemper, 2012;

Mims, 2009; Spooner et al., 2014), shortened the length of the book (Golloher, 2018; Mims, 2009), laminated the pages (Golloher, 2015; Spooner et al., 2009), and attached comprehension questions to the pages (Whalon et al., 2015). Based on the guarded results of this study, implications for stakeholders include allowing the person with a disability to choose what type of book they want to use when targeting different communication skills. Teachers could provide different book format options in classrooms which may be reinforcing and increase participation (Armstrong et al., 2019; Marble-Flint et al., 2020).

Second, a comparison of studies using frontloading or an anticipatory set during the intervention and those that did not revealed no statistically significant differences between them (Zanolli, Daggett, & Adams, 1996). Most of the studies that used anticipatory sets also included a prediction question (Browder 2011; Golloher 2015; Golloher 2018; Spooner 2009; Spooner 2014). Researchers provided participants with the opportunity to choose the book read for the intervention (Browder 2011; Finke 2017; Golloher 2015). Intervention components included a review of the title and author name (Golloher 2018; Spooner 2009; Spooner 2014) and manipulation of parts of the book such as the cover (Spooner 2009; Spooner 2014). Finally, implementers previewed vocabulary words with the children in the studies (Finke 2017; Kemper 2012). Implications indicate that practitioners may or may not choose to use elements of the anticipatory set with children who have disabilities should child specific needs warrant additional attention grabbers prior to reading the story. Time used on the anticipatory set

strategy could instead be used to review story grammar elements, sequence pictures of events that happened in the story, or verbally retell the story.

Third, there were no statistically significant differences between studies using high-technology, low-technology, or a combination of AAC types. In terms of high-technology AAC, one study used a Samsung tablet with EasyVSD software (Boyle, 2018), three used Proloquo2GoTM (Finke, 2017; Lorah, 2017; Sennott, 2013), two used a tablet with the GoTalk Now© application (Spooner, 2014; Therrien, 2018), and one reported use of a voice output communication device available in the classroom (Browder, 2011). In terms of low-technology AAC, all of the studies utilized pictures for communication and one also used objects (Golloher, 2015). Given the results and limitations of this meta-analysis, practitioners should consider factors such as cost, ease of use, efficiency in instruction, and stakeholder preference for a particular device when matching the device with the person who has a disability (Boot et al., 2018).

Results of this study are similar to that of other reviews examining the impact of interventions targeting reading in terms of findings indicating moderate to very large effects. One primary focus of previous literature has been on single word reading skills. Researchers have cited the need for more comprehensive reading interventions that target a variety of skills that are comparable to students receiving the general education curriculum (Mandak, Light, & Boyle, 2018; Roberts et al., 2013). Similar to the current study, reading comprehension has also been successfully targeted in studies (Boyle, McNaughton, & Chapin, 2019; Browder et al.; 2006; Hudson & Test, 2011). Also of

interest is the discrepancy between the outcomes of individuals who are verbal and those that use AAC with smaller effect sizes resulting for those who use AAC (Boyle, McNaughton, & Chapin, 2019). Finally, studies in the current meta-analysis used adapted texts for the intervention, which is similar to previous research (Hudson & Test, 2011).

Limitations and Future Research

Limitations to this review also deserve attention. First, few studies met the inclusion criteria for this review possibly because the use of high-technology devices for reading interventions is an emerging area of research (Roberts et al., 2013). The inclusion of a limited number of studies limits the generalizability of the findings so future work that includes more individuals with ASD and targets a variety of skills would be beneficial (Mandak, Light, & Boyle, 2018). Second, studies conducted most of the intervention procedures in schools and used one-to-one formats. Previous studies revealed no differences between one-to-one and group settings, thus the implementation of storybook reading interventions in a variety of settings, such as homes and childcare settings, may be beneficial (Mandak, Light, & Boyle, 2018). Group design studies were not included in this review. The use of more group designs may provide evidence of the efficacy of group based interventions that may impact a greater number of individuals with disabilities and provide opportunities for comparisons between groups of individuals with and without disabilities (Lo & Shum, 2020). Low inter-observer agreement for some variables of this study is also a limitation. Lack of reporting or inclusion of individuals who are English Language Learners in the studies included in

this literature review points to the need for the inclusion of diverse participants. Finally, future reviews of the literature may benefit from having broader search criteria to include books created by the authors of studies.

Conclusion

The outcomes of this systematic review and meta-analysis revealed statistically significant outcomes with moderate to very strong effect sizes for storybook reading interventions on the language skills of individuals with ASD/ID and physical disabilities. There were no statistically significant differences between factors of moderators. Results should be interpreted with caution due to the limited number of studies included in each disability category and the other limitations indicated.

Table 7 Search Terms and Databases

ERIC EBSCO
DE "Childrens Literature" or DE "Story Reading" or AB (((childrens or illustrated or picture) n1 book*) or (shared n1 (stories or story)) or (repeated n1 reading)) OR TI (((childrens or illustrated or picture) n1 book*) or (shared n1 (stories or story)) or (repeated n1 reading)) OR (AB(storybook*) or AB(shared n1 reading) AND (SU "Augmentative and Alternative Communication" or AB ("Augmentative and Alternative Communication" or aac) or TI ("Augmentative and Alternative Communication" or aac)) OR ((DE "Pervasive Developmental Disorders" OR DE "Asperger Syndrome" OR DE "Autism") OR (DE "Developmental Disabilities" OR DE "Intellectual Disability" OR DE "Down Syndrome" OR DE "Mild Intellectual Disability" OR DE "Moderate Intellectual Disability" OR DE "Severe Intellectual Disability")) OR TI (autism or asd or pdd or ((developmental or intellectual) n1 disabil*) or (Down n1 Syndrome)) OR AB (autism or asd or pdd or ((developmental or intellectual) n1 disabil*) or (Down n1 Syndrome)) OR SU "Nonverbal Communication" or TI (((((speech generating) or (Voice output)) n2 (device* or aid*)) or sgd or “big mac” or ((alternative or augmentative) n1 communication*)) or (aided language stimulation) or ccn or (“complex communication needs” or (nonverbal* or (minimal* n1 verbal*))) OR AB (((((speech generating) or (Voice output)) n2 (device* or aid*)) or sgd or “big mac” or ((alternative or augmentative) n1 communication*)) or (aided language stimulation) or ccn or (“complex communication needs” or (nonverbal* or (minimal* n1 verbal*)))
Academic Search (EBSCO)
AB (((childrens or illustrated or picture) n1 book*) or (shared n1 (stories or story)) or (repeated n1 reading)) OR TI (((childrens or illustrated or picture) n1 book*) or (shared n1 (stories or story)) or (repeated n1 reading)) OR (AB(storybook*) or AB(shared n1 reading) AND AB ("Augmentative and Alternative Communication" or aac) or TI ("Augmentative and Alternative Communication" or aac)) OR OR TI (autism or asd or pdd or ((developmental or intellectual) n1 disabil*) or (Down n1 Syndrome)) OR AB (autism or asd or pdd or ((developmental or intellectual) n1 disabil*) or (Down n1 Syndrome)) OR SU "Nonverbal Communication" or TI (((((speech generating) or (Voice output)) n2 (device* or aid*)) or sgd or “big mac” or ((alternative or augmentative) n1 communication*)) or (aided language stimulation) or ccn or (“complex communication needs” or (nonverbal* or (minimal* n1 verbal*))) OR AB (((((speech generating) or (Voice output)) n2 (device* or aid*)) or sgd or “big mac” or ((alternative or augmentative) n1 communication*)) or (aided language stimulation) or ccn or (“complex communication needs” or (nonverbal* or (minimal* n1 verbal*))
PSYCInfo
AB (((childrens or illustrated or picture) n1 book*) or (shared n1 (stories or story)) or (repeated n1 reading)) OR TI (((childrens or illustrated or picture) n1 book*) or (shared n1 (stories or story)) or (repeated n1 reading)) OR (AB(storybook*) or AB(shared n1 reading) AND ((DE "Autism Spectrum Disorders") OR (DE "Nonverbal Communication")) OR (DE "Developmental Disabilities" OR DE "Specific Language Impairment") OR AB ("Augmentative and Alternative Communication" or aac) or TI ("Augmentative and Alternative Communication" or aac)) OR OR TI (autism or asd or pdd or ((developmental or intellectual) n1 disabil*) or (Down n1 Syndrome)) OR AB (autism or asd or pdd or ((developmental or intellectual) n1 disabil*) or (Down n1 Syndrome)) OR SU "Nonverbal Communication" or TI (((((speech generating) or (Voice output)) n2 (device* or aid*)) or sgd or “big mac” or ((alternative or augmentative) n1 communication*)) or (aided language stimulation) or ccn or (“complex communication needs” or (nonverbal* or (minimal* n1 verbal*))) OR AB (((((speech generating) or (Voice output)) n2 (device* or aid*)) or sgd or “big mac” or ((alternative or augmentative) n1 communication*)) or (aided language stimulation) or ccn or (“complex communication needs” or (nonverbal* or (minimal* n1 verbal*))
Education Source
((DE "Autism") OR (DE "Developmental disabilities" OR DE "Autism" OR DE "Down syndrome" OR DE "Mental disabilities" OR DE "Smith-Lemli-Opitz syndrome")) OR (DE "Nonverbal communication in education") OR AB ("Augmentative and Alternative Communication" or aac) or TI ("Augmentative and Alternative Communication" or aac)) OR OR TI (autism or asd or pdd or ((developmental or intellectual) n1 disabil*) or (Down n1 Syndrome)) OR AB (autism or asd or pdd or ((developmental or intellectual) n1 disabil*) or (Down n1 Syndrome)) OR SU "Nonverbal Communication" or TI (((((speech generating) or (Voice output)) n2 (device* or aid*)) or sgd or “big mac” or ((alternative or augmentative) n1 communication*)) or (aided language stimulation) or ccn or (“complex communication needs” or (nonverbal* or (minimal* n1 verbal*))) OR AB (((((speech generating) or (Voice output)) n2 (device* or aid*)) or sgd or “big mac” or ((alternative or augmentative) n1 communication*)) or (aided language stimulation) or ccn or (“complex communication needs” or (nonverbal* or (minimal* n1 verbal*)) AND

Table 7 Continued

AB (((childrens or illustrated or picture) n1 book*) or (shared n1 (stories or story)) or (repeated n1 reading)) OR TI (((childrens or illustrated or picture) n1 book*) or (shared n1 (stories or story)) or (repeated n1 reading)) OR (AB(storybook*) or AB(shared n1 reading)
Linguistics and Language Behavior Abstracts
MAINSUBJECT.EXPLODE("Childrens Literature") OR ((((childrens or illustrated or picture) N/1 book*) or (shared N/1 (stories or story)) or (repeated N/1 reading)) OR storybook* or(shared N/1 reading)) AND (MAINSUBJECT("Developmental Disabilities") OR MAINSUBJECT("Augmentative and Alternative Communication") OR MAINSUBJECT("Nonverbal Communication") OR MAINSUBJECT("Autism")) OR noft("Augmentative and Alternative Communication" OR aac OR autism OR asd OR pdd OR sgd OR "big mac" OR "aided language stimulation" OR ccn OR "complex communication needs" OR nonverbal*) OR noft((down* NEAR/1 syndrome) OR ((alternative OR augmentative) NEAR/1 communication*) OR ((developmental OR intellectual) NEAR/1 disabil*) OR (minimal* NEAR/1 verbal*)) OR noft(("speech generating" or "voice output") and (device* OR aid*))
Proquest Dissertations and Theses Global
all(storybook or "story book") AND all((alternative and augmentative communication) or aac)

Table 8 Design Quality Criteria and Ratings

Criteria	Ratings
(a) Was the independent variable manipulated?	1 = Study was designed in a way that a functional relation can be detected if present. 0 = Study was not designed in a way that a functional relation can be detected.
(b) Did researchers collect inter-observer agreement data?	1 = Inter-observer agreement data taken. 2 = Inter-observer agreement was not taken.
(c) Was inter-observer agreement taken on 20% of data points?	1 = agreement was taken on 20% of phases. 2 = Agreement was collected, but it was not specifically stated that agreement collected for 20% of phases. 0 = agreement was not reported or study states that agreement was collected for less than 20% of conditions
(d) Was agreement at least 80% or .60 kappa for each phase?	2 = Agreement percentage was 80% or .60 kappa for each phase. 2 = Report of 80% or .60 agreement, but not indicated for each phase. 0 = Agreement minimums not met.
(e) Were there at least three attempts to demonstrate an effect?	1 = There were at least 3 attempts to demonstrate an effect, at 3 different times (or two attempts to demonstrate an effect for alternating treatment designs). 0 = There were not 3 attempts to demonstrate an effect, at 3 different times.
(f) How many data points were collected per phase and per participant?	Multiple-baseline or multiple-probe design 2 = There were six baseline and intervention phases with 5 data points for each phase 1 = There were six baseline and intervention phases with at least 3 data points for each phase 0 = There were less than 3 data points for a phase Reversal 2 = At least 4 phases and 5 data points per phase 1 = At least 4 phases and 3 data points per phase 0 = There were less than 3 data points for a phase Alternating Treatment Design 2 = sequence repeats itself at least 5 times and 5 data points were collected for each sequence 1 = Two conditions repeated themselves at least four times 0 = There were two sequences that were repeated less than four times

Table 9 Inter-rater Reliability

Study Selection	
Title and Abstract	87% (100%)
Full Text	32% (96%)
Quality	52% (83%)
Variable Coding	
Age	75% (100%)
Intervention Setting	75% (90%)
English Language Learner	75% (100%)
Services Received	97% (83%)
Years of Experience	75% (86%)
Outcome	75% (93%)
Implementation Format	97% (75%)
Intervention Minutes	100% (100%)
Data Extraction	
Data Extraction	100% (89%)

Note. Percentage of articles coded indicated outside of parenthesis and reliability indicated inside of the parenthesis.

Table 10 Descriptive Information ASDID

Study	Age	Setting	PT	ELL	Services	Experience	DV	Format
Alison (2017)	8-10	CR	PR	Yes	SPED	4-7	Answering comprehension question	1:1
Boyle (2018)	4;8-4;9	CR	D	No	ST, OT	8-11	Sight word to picture matching	SG
Browder (2007)	12-13;6	CR	PR	No	NR	2-13	Task analysis student responses	SG
Browder (2011)	9	CR	PR	No	SPED	17-20	Comprehension and engagement	1:1
Browder (2013)	11-13	Other	PR	No	SPED	4-7	Answering comprehension questions	1:1
Courtade (2013)	6-8	CR	PR	No	SPED	4-7	Academic engagement time	SG
Dexter (1998)	6;5-9;3	NR	D	No	SPED, ST, OT	12-16	Picture symbol responses	1:1
Finke (2017)	9-13	CR; Other	PR	Yes; No	SPED, Behavior Specialist, Music Therapy	NR	Multisymbol message use	1:1
Golloher (2015)	4;3-5;2	CR	D	Yes; No	Vision, O/M, SPED, PT, OT, ST	4-7	Task analysis completion	SG
Golloher (2018)	4;1-10;6	Home	PR	Yes; No	SPED	NR	Engagement	1:1
Kemper (2012)	5-8	NR	D	Yes	SPED, ST, OT	0-7	Comprehension question responses; Number responses to comprehension questions; Engagement	1:1
Kent-Walsh (2010)	4;7-5;11	Home	PR	No	NR	NR	Communicative turns	1:1
Lee (2012)	6;8-10;10	CR	D	No	SPED, ST, PT, OT	25	Task analysis responses	SG
Lorah (2017)	3;6-4;2	CR	PR	No	ABA	NR	Tacting independently	1:1
Mandak (2019)	3;7-4;7	CR; Other	PR	No	SPED, ST	NR	Identify words on device	1:1
Mims (2009b)	11	CR	D	No	SPED	4-16	Answering comprehension questions	1:1
Na (2015)	5;1-9;8	Home	D	No	NR	NR	Frequency child utterances	1:1

Table 10 Continued

Study	Age	Setting	PT	ELL	Services	Experience	DV	Format
Nasir-Tucktuck (1998)	NR	CR	D	No	SPED	0-3	Answering comprehension questions	1:1
Pitman (2015)	6;6-8;8	Other	Thesis	Yes; No	ST, SPED	NR	Single & multisymbol message choice	1:1
Sennott (2013)	3;9-4;7	Other	D	No	SPED	0-7	Frequency communication turns	1:1
Spooner (2008)	7-11	Other	PR	No	SPED	12-16	Answering comprehension questions	1:1
Spooner (2009)	6	CR	PR	Yes	SPED	8-11	Literacy responses	1:1
Spooner (2014)	8-12	CR	PR	No	SPED	8-11	Task list responses; Comprehension question responses	1:1
Stephenson (2009)	7	CR	PR	Yes	SPED	NR	Responding via AAC	SG
Su (2019)	3;3-7;4	Clinic	PR	No	ST	NR	Receptive and expressive vocabulary responses	1:1
Therrien (2018)	3;9-5;3	Other	PR	No	SPED	NR	Communication turns	SG
Whalon (2015)	4-5	CR	PR	No	SPED, ST, OT, Vision	NR	Verbal and nonverbal initiations	SG
Whalon (2016)	4	Home	PR	No	SPED	NR	Answering comprehension questions	1:1
Yorke (2018)	4;10	Other	PR	No	SPED, ST	NR	Responding via AAC	1:1

Note. Age in years. CR=Classroom, Other=Other Room in School, PT=Publication Type, PR=Peer-reviewed, D=Dissertation, ELL=English Language Learner, Services=Type of services child received, SPED=special education, ST=Speech Therapy, OT=Occupational Therapy, O/M=Orientation and Mobility, ABA=Applied Behavior Analysis, NR=Not Reported, Experience=Implementer years of experience working with individuals who have disabilities reported in years, AAC=Augmentative and Alternative Communication, Format=Study Implementation Format, 1:1=One-to-one, SG=small group,

Table 11 Descriptive Information Physical Disabilities

Study	Age	Setting	PT	ELL	Services	Experience	DV	Format
Browder (2007)	14	CR	PR	No	NR	2-13	Task analysis responses	SG
Browder (2008)	7-10	CR	PR	No	SPED, OT, PT, ST	4-7	Student responses during reading	1:1
Browder (2011)	6-9	CR	PR	No	SPED	4-20	Comprehension and engagement	1:1
Edmister (2015)	8-9	Home, Other	PR	No	SPED	NR	Number communication turns	1:1
Ho (2000)	4;7-5;10	Other	D	No	ST	0-3	Percentage of symbols identified; Number of sessions to criterion	1:1
Hudson (2012)	10	CR	D	No	SPED	0-3	Picture symbol use	1:1
Kent-Walsh (2010)	5;0-8;3	Home	PR	No	NR	NR	Communicative turns	1:1
Lee (2012)	10;9-11;9	CR	D	No	ST, PT, OT, DB	25	Task analysis responses	SG
Mims (2009b)	11	CR	D	No	SPED	4-16	Comprehension question responses	1:1
Roberts (2013)	11-12	NR; Other	PR	No	PT, OT, ST, SPED	10; NR	Vocabulary identification on device	1:1
Rodrigues (2016)	7	CR	PR	NR	SPED	NR	Answering comprehension questions	1:1
Spooner (2008)	9	Other	PR	No	SPED	12-16	Comprehension question responses	1:1
Stephenson (2009)	7	CR	PR	Both	SPED	NR	Touching correct responses	SG

Note. Age in years. CR=Classroom, Other=Other Room in School, PT=Publication Type, PR=Peer-reviewed, D=Dissertation, ELL=English Language Learner, Services=Type of services child received, SPED=special education, ST=Speech Therapy, OT=Occupational Therapy, DB=Deaf services, NR=Not Reported, Experience=Implementer years of experience working with individuals who have disabilities reported in years, AAC=Augmentative and Alternative Communication, Format=Study Implementation Format, 1:1=One-to-one, SG=small group

Table 12 ASDID Moderator Analyses

Moderator	*K*	Participants	Experiments	A-B PC	Tau-*U*	95% CI	*p*	Status	Q_w
Quality Comparison									
MWR	21	72	43	113	.7936	[.6359, .9514]	<.0001*	Large	
DNM	10	29	23	49	.7743	[.5064, 1.0422]	<.0001*	Large	
Overall	31	101	66	162	.7887	[.6527, .9246]	<.0001*	Large	
Book Type								6.1138	
Adapted Paperback	15	45	23	72	.8016	[.6115, .9916]	<.0001*	Large	
Paperback	13	47	35	81	.7758	[.5620, .9897]	<.0001*	Large	
Book on application	2	5	2	5	.6627	[.0699, 1.2554]	.0284*	Moderate	
Combination	1	4	6	4	.9524	[.1893, 1.7155]	.0144*	Very Large	
Frontloading								6.4231	
Yes	14	40	20	57	.8102	[.6029, 1.0176]	<.0001*	Large	
No	17	61	46	105	.7724	[.5924, .9524]	<.0001*	Large	
AAC Type								5.5676	
Low	14	45	31	78	.7690	[.5707, .9674]	<.0001*	Large	
High	10	35	17	50	.7366	[.4991, .9742]	<.0001*	Moderate	
Combination	7	21	18	34	.9181	[.6162, 1.2200]	<.0001*	Very Large	

Note. K = number of studies, CI = Confidence Interval, *p* = *p*-value, Q_w = Q_within, MWR = Studies meeting quality indicators criteria with reservations, DNM = Studies that did not meet quality indicators criteria, A-B PC=A-B Phase Comparisons.

Table 13 Physical Disability Moderator Analyses

Moderator	*K*	Participants	Experiments	A-B PC	Tau-*U*	95% CI	*p*	Status	Q_w
Quality Comparison									
MWR	9	18	21	47	.7168	[.4489, .9847]	<.0001*	Moderate	
DNM	4	5	11	5	.8668	[.4180, 1.3157]	.0002*	Large	
Overall	13	23	32	52	.7562	[.5262, .9862]	<.0001*	Large	
Book Type									3.4957
Adapted Paperback	8	13	11	22	.8773	[.5617, 1.1930]	<.0001*	Large	
Paperback	4	8	15	28	.4883	[.0968, .8799]	.0145*	Moderate	
Combination	1	2	6	2	.9829	[.3296, 1.6362]	.0032*	Very Large	
Frontloading									6.3168
Yes	7	12	11	18	.7475	[.4111, 1.0839]	<.0001*	Moderate	
No	6	11	21	34	.7638	[.4486, 1.0791]	<.0001*	Large	
AAC Type									3.9974
Low	6	9	14	29	.6169	[.2641, .9698]	.0006*	Moderate	
High	2	3	4	4	.5569	[-.0475, 1.1614]	.0709	Moderate	
Combination	5	11	14	19	.9609	[.6102, 1.3116]	<.0001*	Large	

Note. K = number of studies, CI = Confidence Interval, *p* = *p*-value, Q_w = Q_within, MWR = Studies meeting quality indicators criteria with reservations, DNM = Studies that did not meet quality indicators criteria, A-B PC = A-B Phase Comparisons.

Figure 3 Overall Forest Plot ASD/ID Studies

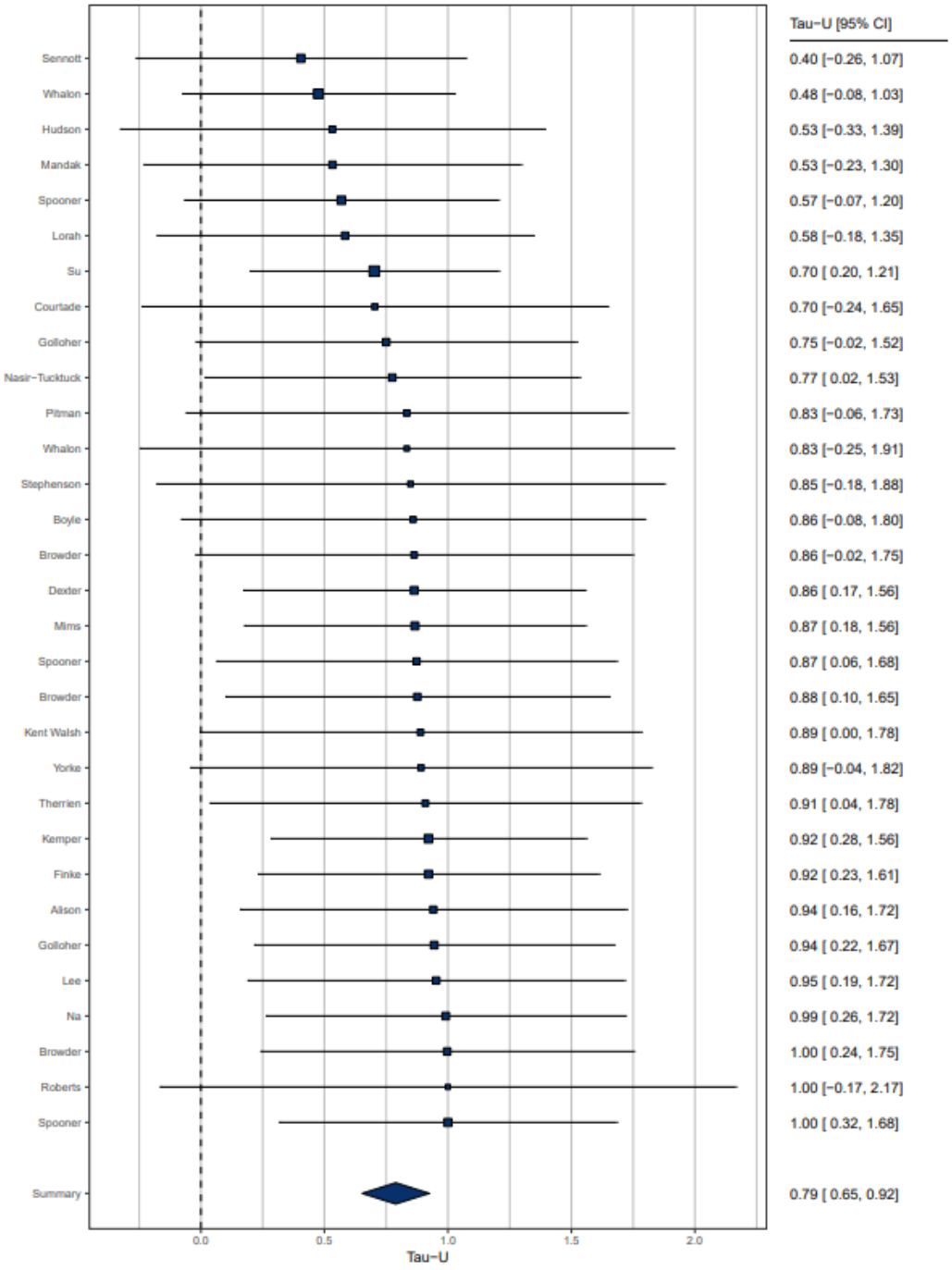


Figure 4 Forest Plot ASD/ID Meets with Reservations and Does Not Meet Standards

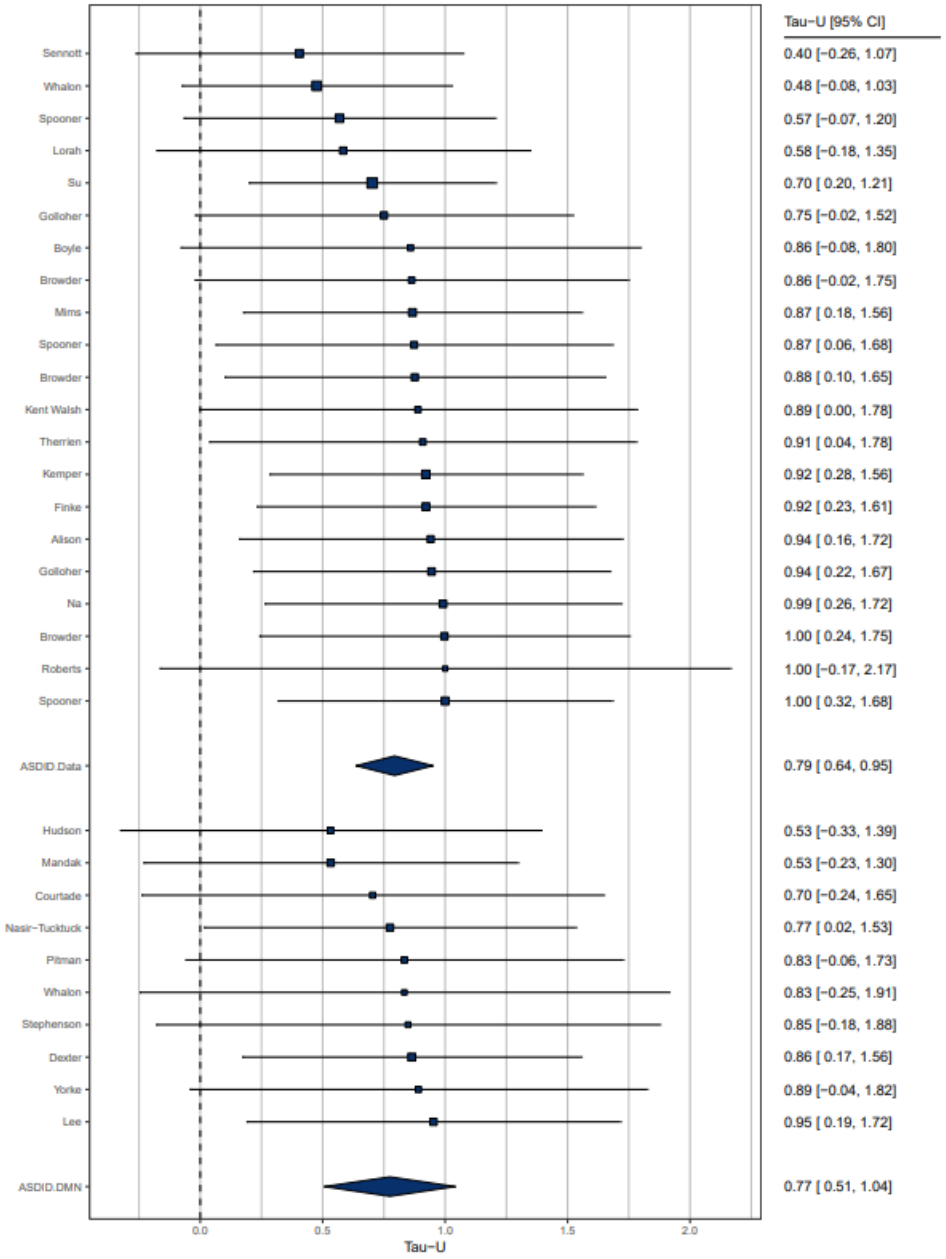


Figure 5 Overall Forest Plot Physical Disability Studies

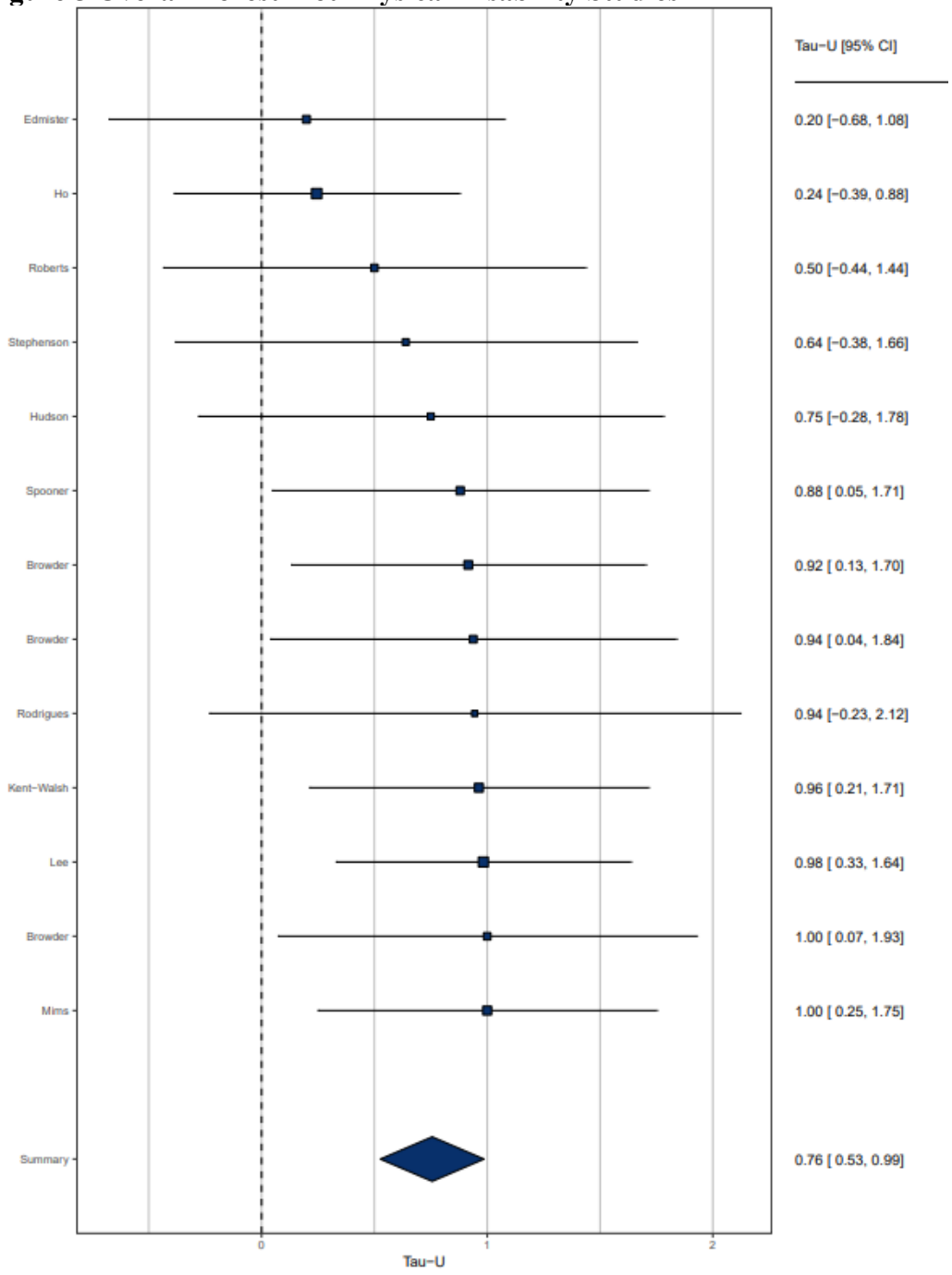


Figure 6 Forest Plot Physical Disability Meets with Reservations and Does Not Meet Standards

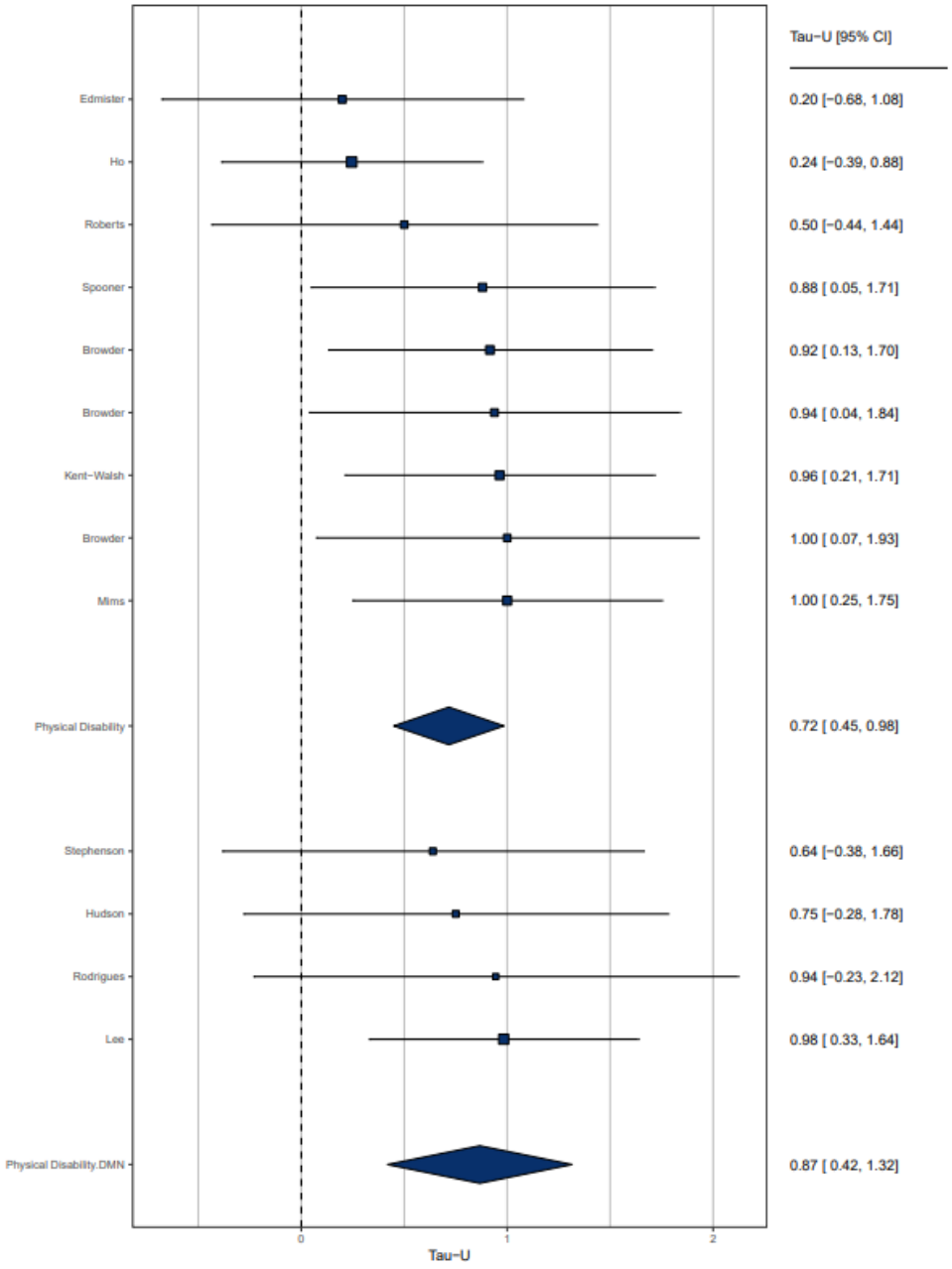


Figure 7 ASD/ID Funnel Plot Right Side

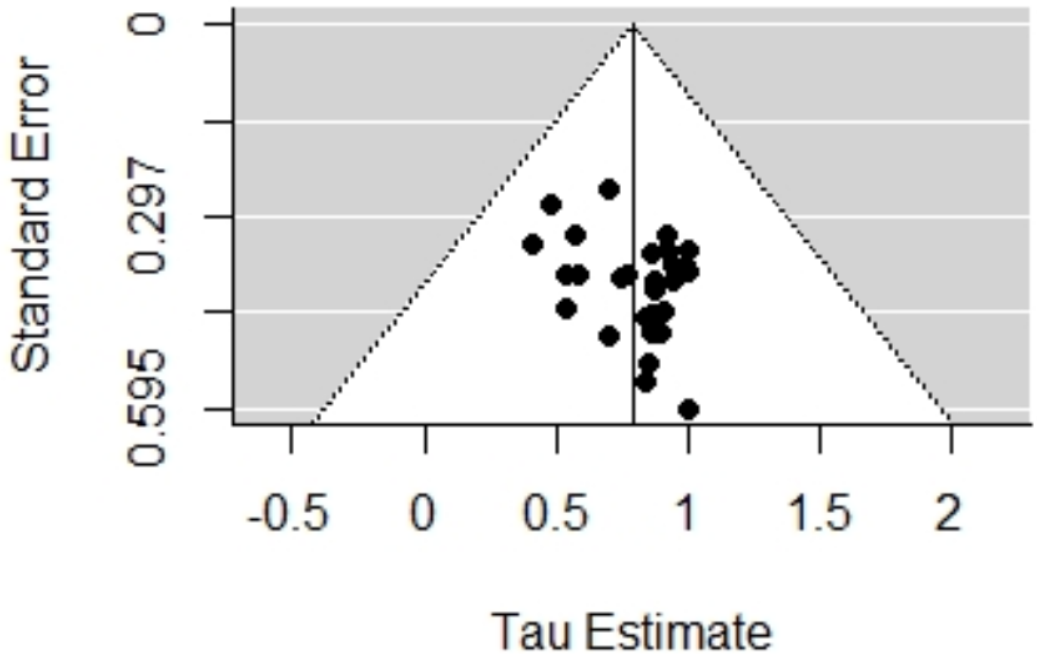


Figure 8 ASD/ID Funnel Plot Left Side

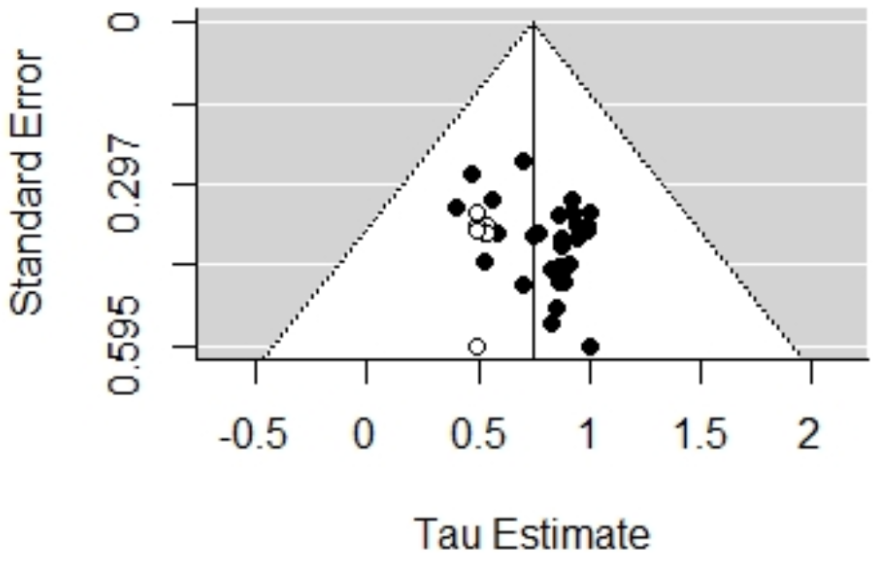


Figure 9 Physical Disability Funnel Plot Right Side

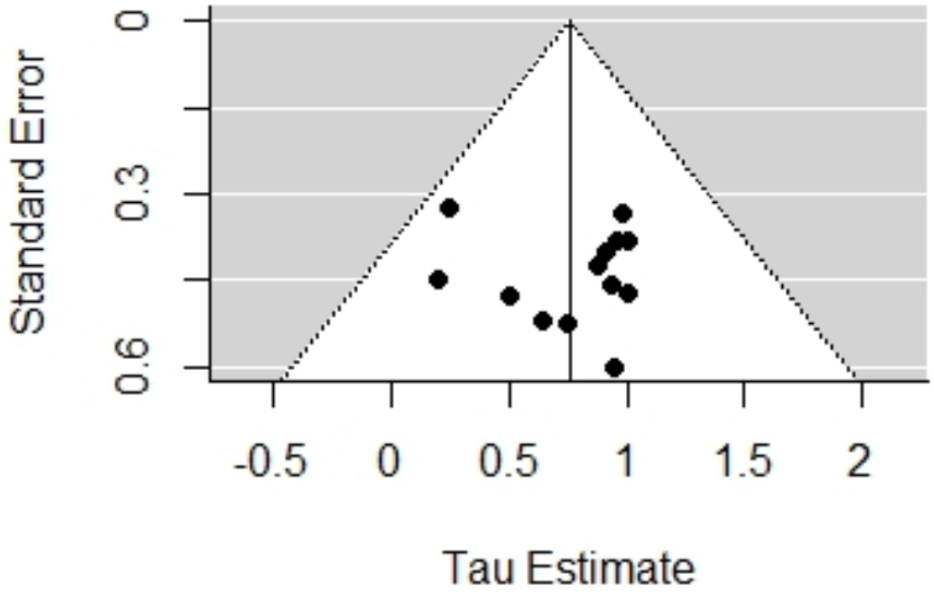
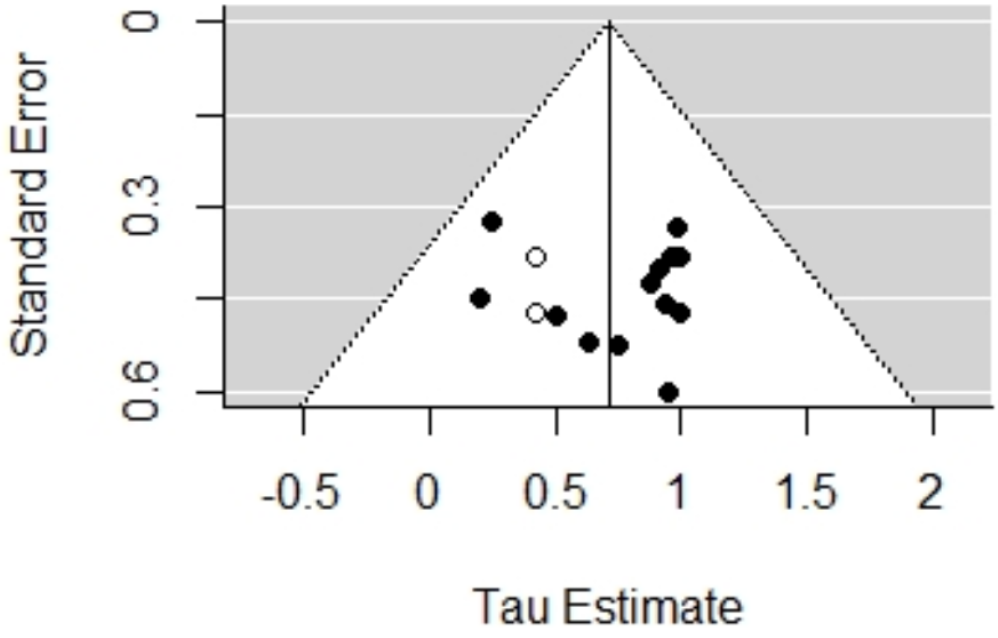


Figure 10 Physical Disability Funnel Plot Left Side



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CHAPTER IV

SOCIAL VALIDITY, AFFORDABILITY, ACCEPTABILITY, AND FEASIBILITY OF AUGMENTATIVE AND ALTERNATIVE COMMUNICATION (AAC) DEVICES USED FOR INDIVIDUALS WITH ASD AND ID: A SYSTEMATIC REVIEW

Introduction

Individuals including those with and without disabilities spend approximately 144 minutes of each day using technology for various reasons (Statista, 2019b). Those with disabilities are at a disadvantage in accessing devices, obtaining assistance with device operation, and having device features to sufficiently accommodate their disability (Cullen et al., 2010). The transition to adulthood and employment can be particularly difficult for those relying on technology to carry out activities of daily living such as communication or hygiene, or for technology use in the community to afford an equal opportunity to participate. There is also a lack of resources available to those who could benefit from using different types of devices. Resources include appropriate personnel to help choose the best device for the person with a disability, general assistance with device operation, and the number of different types of technology options to address a number of different needs. Persons with disabilities may have difficulty with making phone calls, purchasing goods, navigating to a different place, or maintaining a schedule (Boot et al., 2018; Khanlou et al., 2020). The cost of the device for individuals with disabilities (i.e., affordability), a careful feature match to their unique abilities,

willingness to use the device (i.e., acceptability), and ease of use (i.e., feasibility) are important considerations (Khanlou et al., 2020).

Individuals with a spoken language disability may require additional forms of technology to supplement speech or as an alternative means of communicating (Clarke & Williams, 2020). Creer et al. (2016) found 100 out of 100,000 people with autism spectrum disorder (ASD) may be candidates for augmentative and alternative communication (AAC). Unaided AAC utilizes only the individual's body parts for communication, while aided AAC requires a supplemental device such as a low-technology communication board or speech generating device (SGD) as a means of communication. People with disabilities may use a combination of systems or one type may stand alone (Ganz et al., 2019). In this study, we included studies using aided communication consisting of a high-technology SGD. High-technology included a SGD that is powered by a battery, plugged into a power outlet, or plugged into a computer by either pushing or tapping a button or icon (e.g., pushing a button on an application, tapping a button that produces voice output). High-technology can be differentiated from low-technology aided communication which uses no power source and where the user interacts with the device by pointing to, picking up, or handing a picture icon, object, or other item to another person (e.g., handing a picture icon to another person to indicate a choice).

AAC devices can benefit those with disabilities by increasing communication production and comprehension (O'Neill, Light, & Pope, 2018), engagement (Caron, Light, & Drager, 2016), and social-communication (Biggs, Carter, Bumble, Barnes, &

Mazur, 2018). These are particularly important given that deficits in social communication are diagnostic criteria for ASD, Down syndrome and a host of other developmental disabilities (CDC, 2019; NIH 2017). Communication deficits can cause a strain on peer relationships (Ferreira, Aguiar, Correia, Fialho, & Pimentel, 2019; Son, Peterson, Pottick, Zippay, Parish, & Lohrmann, 2014), isolation (Gamelas, 2003), decreased social connectedness (Biggs et al., 2018; Raghavendra, Olsson, Sampson, Mcinerney, & Connell, 2012), lack of authentic friendships, and inadequate networks of support (Light, & Mcnaughton, 2015). Thus, the development of interventions that are affordable, feasible, and acceptable to stakeholders--including family members and educators--should be a focus.

The implementation of socially valid interventions is important for stakeholder uptake and has recently been included as a component of study methodological quality (Horner et al., 2005; Reichow et al., 2008). The origin of the concept of social validity lies in applied behavior analysis. Introduced by Wolf (1978), social validity is defined as an assessment of the objectives of the study, adequacy of the intervention procedures, and outcomes of the experiment, which ultimately impacts individuals with disabilities in a positive way. Wolf suggested that the consideration of factors beyond the objective toward the subjective was necessary. Nearly a decade later, Baer, Wolf, and Risley (1987) provided an in depth discussion of social validity and described its potential to shape practices in the field of special education, particularly taking the uptake and acceptance of educational interventions into consideration. Schwartz and Baer (1991) called on researchers to use social validity measures as originally intended and suggested

collecting information about the assessor and the kinds of questions that were asked during the interview. Kennedy (1992) separated social validity components into subjective and normative data. Subjective data are those involving stakeholder opinions of the intervention, whereas normative evaluations make comparisons between individuals with disabilities and those who are typically developing (Kennedy, 1992). Subjective data can provide feedback about the intervention that is specific to the individual's experience and may not be covered in a questionnaire or survey (e.g., feedback about how well the SGD operated during the intervention). Normative data provide concrete comparisons and are potentially less subject to bias from respondents' individual perspectives (e.g., Ledford & Gast, 2018). This systematic review includes both subjective and normative data.

Affordability dramatically affects the likelihood that individuals will choose high-technology AAC devices (Khanlou et al., 2020). Stakeholders may have a difficult time acquiring a device to use and may lack access to personnel qualified to perform assessments and teach the child how to use the device (Mechling et al., 2013). Additionally, performing device maintenance such as replacing batteries, upgrading technology applications, or repairing the device if it breaks may be difficult for stakeholders (Angelo, 2009). Recently, researchers have noted an increased interest in device cost (Alzrayer, Banda, & Koul, 2019) and have developed lower cost high-technology AAC options (Laxmidas et al., 2021).

Considering factors to promote SGD acceptability is imperative for long-term use of the device (Moorcroft, Scarcity, & Meyer, 2019). Stakeholders have many

decisions to make when working with those who have disabilities, including whether to use a SGD, a low-tech option, or both in combination. Choosing an SGD can be challenging (West et al., 2020). Incorporation of elements unique to the individual may increase the likelihood the device is used. Seeking input from individuals who know the person with a disability and other stakeholders may also increase the likelihood that individuals with disabilities may continue to use the device after the intervention ends (Fäldt et al., 2020; Swett, et al., 2020). The number of sessions per week, which relates to the amount of time it takes to teach the individual skills on a device, is also important because of the addition of this task in already busy schedules may make it difficult for caregivers to learn to use the device (Biggs et al., 2019).

Devices should be acceptable and feasible for a consumer to use. Parents may become frustrated when they find using the device is demanding and initially think the operation will be solely directed by a professional (Moorcroft, Scarcity, & Meyer, 2019). The SGD itself may stop working, require a new battery, not be available when needed, or not be easy to transport. Similarly, the SGD's volume may not be sufficient for some settings without additional amplification, or the voice output rate may require adjustment for optimal use in naturalistic contexts (Baxter, et al., 2012; Moorcroft, Scarcity, & Meyer, 2019). This review will address acceptability factors in order to promote a better understanding of where the AAC literature currently stands and inform the future practice of practitioners, clinicians, and researchers working with individuals who have disabilities.

In addition to acceptability of the SGD, it is important to consider decisions surrounding the planning and implementation of experimental studies (Machalicek, 2008). There is an obligation to consider social validity during the planning stages of the study to determine if the research is ethical in nature, assess whether it is appropriate for the individual, and plan for any bias that may arise (Halle, 2019). Professionals such as speech-language pathologists and applied behavior analysts are also required to comply with ethical standards indicated by a code of ethics (ASHA, 2016; BACB, 2014), which include considering the social validity of interventions, intervention targets, and relevant contexts.

These studies involve individuals with disabilities such as ASD are largely single-case designs (Ledford & Gast, 2018). The Council for Exceptional Children Quality Indicators criteria for single-case designs require the inclusion of social validity measures for a study to be considered high-quality research (Cook, Buysse, Klingner, Landrum, McWilliam, Tankersley, & Test, 2014). Other researchers have recommended the inclusion of measures of social validity in research (Ganz & Ayres, 2018; Reichow, Volkmar, & Cicchetti, 2008) and underscored the importance of social validity to the uptake of evidence-based practices (Horner, Carr, Halle, McGee, Odom, & Wolery, 2005). Even with these advances, there remains a need to investigate social validity factors in the AAC literature in detail.

Synthesis of the Research

Stakeholders involved with children who have disabilities, such as parents, speech-language pathologists, and educators, are typically charged with teaching the

individual how to use an AAC device, updating vocabulary on the SGD as individual needs change, and maintaining the SGD. Research in stakeholder use and satisfaction with AAC has largely been qualitative in nature. This includes survey research exploring the experiences of teachers (Schäfer, et al., 2016; Tegler, Pless, Blom Johansson, & Sonnander, 2019; Aldabas, 2019), caregivers (Tegler, Pless, Blom Johansson, & Sonnander, 2019), families (Meder & Wegner, 2015), and speech-language pathologists (Pampoulou, 2019) who work with people with complex communication needs. The current body of literature indicates several barriers for the use of AAC, including slower communication speed, increased effort, negative reactions, and lack of a communication means during routine maintenance (Ripat, Verdonck, Gacek, & McNicol, 2019).

In their review of aided AAC to teach social communication, Logan, Iacono, & Trembath (2017) indicated that a quarter of the studies reported information about the procedures and nine out of 24 reported outcomes. Similarly, Chung et al. (2012) reported that less than 40% of studies reported procedures, outcome, or goal information. In a study by Morin et al. (2018), 57% of the studies met the US Department of Education (WWC), (2016) standards with reservations when rated for social validity. Components of the social validity standards for the Morin review included a determination if the dependent variables are socially important, the intervention is cost-effective and efficient, there was a change in behavior because of the intervention, stakeholders believed the procedures were acceptable, and there were naturalistic aspects of the intervention. A qualitative review of barriers to device uptake by Moorcroft and colleagues indicated problems with using the device. No studies have reported findings

on affordability or feasibility to our knowledge, and the aforementioned reviews provided limited information regarding reporting of social validity components. Thus, the current review aims to study the elements of social validity of AAC interventions reported in the literature.

Purpose of This Systematic Review

While use of AAC has been shown to be a promising practice (WWC single-case design standards: Kratochwill et al., 2010; 2014; U.S. Department of Education, 2017b), research regarding end-user social validity, in addition to affordability, acceptability, and feasibility of these devices is lacking (Light, et al., 2019). Stakeholders may also benefit from taking a closer look at the implementation of social validity measures over time. Thus, we conducted a comprehensive, systematic review of the social validity, affordability, feasibility, and acceptability of augmentative and alternative communication devices used in interventions for individuals with ASD and intellectual disabilities (ID). Research questions for this systematic review include:

Question 1: What elements of pre- and post-intervention subjective and normative social validity data as a part of interventions including participants with ASD or ID who use augmentative and alternative communication did researchers collect?

Question 2: What is the affordability, acceptability, and feasibility of augmentative and alternative communication devices used in interventions for students with ASD and ID?

Question 2: How has reporting of subjective and normative data for goals, procedures, and outcomes of studies changed over time?

Method

Study Identification

Search Procedures

Researchers used a subset of the articles found during a comprehensive meta-analysis related to interventions for individuals with ID and ASD who use augmentative and alternative communication devices. See Ganz et al. (2020) for a detailed description of the methodology. A summary of components that applied to this review is below. A research librarian specializing in search procedures for systematic literature reviews conducted the search using concepts related to developmental disabilities and assistive technology. Databases searched included ERIC (EBSCO), PsycINFO (EBSCO), MEDLINE (Ovid), Cumulative Index of Nursing & Allied Health Literature (EBSCO), Linguistics and Language Behavior Abstracts (ProQuest), Academic Search Complete (EBSCO), Education Source (EBSCO), Education Full Text (EBSCO), and Educational Administration Abstracts (EBSCO). Researchers found gray literature through Conference Proceedings Citation Index – Social Science & Humanities (Web of Science) and ProQuest Dissertations & Theses Global. Search terms included augmentative or alternative, communicat*, sign language, manual sign*, speech-generating device*, (speech generating device) SGD, voice output communication aid, VOCA*, PECS, picture exchange communication system, AAC, visual scene display, functional communication training, down* syndrome, develop* or intellectual, delay* or disabil* or impair, autis* or retard*. The research librarian used a thesaurus to find additional search terms. The search took place October 2018, January 2019, and

researchers updated the using identical search terms in April 2020. Researchers also reviewed the reference sections of articles meeting criteria and other work of first authors of articles meeting criteria at the end of the inclusion/exclusion process to find any additional potential articles meeting criteria. The review process is below.

Title and Abstract Inclusion/Exclusion Criteria

The screening process for the comprehensive review was conducted using Rayyan (Ouzzani, Hammady, Fedorowicz, & Elmagarmid, 2016), a systematic review data management software. Rayyan allows raters to include or exclude articles, provide reasons for exclusion, and mask individual rater choices prior to disagreement resolution. Researchers applied five main categories of inclusion criteria to each article in the following order: (a) *AAC device*, (b) *participants*, (c) *outcomes*, (d) *study design*, and (e) *language*. For the purposes of the larger comprehensive meta-analysis, *AAC devices* included high-technology systems, low-technology systems, manual sign language, exchange-based systems, or multimodal communication. *Participants* included individuals or relevant stakeholders (i.e., parents, educators, service providers) of persons with exclusively or a combination of ASD and ID resulting in complex communication needs. *Outcomes* focused on social-communication or challenging behaviors. While the comprehensive meta-analysis by Ganz et al. (2020) excluded articles related to functional communication training and challenging behaviors, those articles were included in this review. Articles focusing on academic skills and activities of daily living were excluded. *Study designs* included single-case experimental and

group designs. Studies written in English met the *language* criteria for this review.

Full-Text Inclusion/Exclusion Criteria

Following disagreement resolution for titles and abstracts, raters reviewed full-text articles against the inclusion/exclusion criteria. Researchers applied five main categories of inclusion criteria to each article in the following order: (a) *language*, (b) *participants*, (c) *AAC device*, (d) *study design*, (e) *outcome*. Definitions applied during title/abstract stage remained the same with the exception of *study design,* which was further expanded to include multiple-baseline or multiple-probe designs, reversal/withdrawal designs, multi-element/alternating treatment designs, changing criterion designs, AB designs including other variations, complex reversal designs, randomized controlled trials, and quasi-experimental designs.

Design Quality Review

Raters then reviewed group and single case design studies for quality according to criteria adapted from the What Works Clearinghouse standards for single-case research designs (2016; 2018). Researchers filled out a Qualtrics for each article meeting the inclusion criteria (Ganz et al., in review). The basic design standards included (a) a study design in which a functional relation could be detected, (b) inclusion of three attempts to demonstrate a functional relation at three time points (e.g., for a multiple-baseline or multiple-probe design, three different tiers of concurrent data were collected) (c) collection of inter-observer agreement on 20% of the data points in each condition, (d) at least 80% inter-observer agreement obtained, and (e) collection of at least three

data points per phase, with specific requirements for each type of design. See Ganz et al. (in review) for a detailed description of the methodological quality review process.

Article Review

All searches returned 7,327 articles and 1,758 articles met title and abstract inclusion criteria. Five hundred forty seven single-case experimental design articles met full-text criteria and were assessed for methodological quality. Two principal investigators reviewed articles meeting basic design standards (n = 257) and 176 single-case experimental design studies met criteria.

Three undergraduate students in the special education program reviewed the 176 articles included in the larger review to determine which studies used high-technology AAC. The interaction level and the power source were considered when defining high-technology AAC. A device was considered high-technology if it required the user to tap or push a button or icon and required an external power source such as a battery. The first author reviewed the definition of high-technology AAC and raters independently coded a small number of articles until there was 80% point-by-point agreement. Point-by-point agreement can be calculated by dividing the number of agreements by the sum of the number of agreements plus disagreements and multiplying the quotient by 100. Two raters screened all articles and disagreements were resolved by the first author (agreement = 89%). Eighty-six articles that included participants who used high-technology AAC remained for this review.

Variable Coding

Four raters coded each article meeting the inclusion criteria for pre-intervention subjective and normative data, post-intervention subjective and normative data, and AAC descriptive characteristics (in that order). Subjective data include opinions of respondents, while normative data compare outcomes of groups of individuals with and without disabilities (Kennedy, 1992). Subjective data could answer questions about the effectiveness or feasibility of the intervention, and normative data may be a comparison between benchmarks for a skill and the actual results of the intervention. The coding scheme for the pre-intervention and post-intervention social validity portions of this review extend the work of Kennedy (1992), who reviewed articles from behavior analysis literature. We used Kennedy's definitions for both the pre- and post-intervention elements, with the exception of the post-intervention normative procedures. While few studies use normative informative for the purposes of decision making (Carter & Wheeler, 2018), application in the creation of study procedures may be best done prior to the intervention rather than after the intervention has already taken place (Ledford & Gast, 2018). Researchers in the current review added codes for the respondents (e.g., parent/caregiver/group home worker, child or adult participant, teacher, therapist/clinician, community member, job coach, peer), and the data collection method (e.g., questionnaire/survey, interview, anecdotal feedback). See Table 14 for a coding manual of dependent measures, questions, and answer choices for pre- and post-intervention data, and data related to affordability, acceptability, and feasibility of AAC.

Affordability data collected involved open-ended responses. Raters provided verbatim information from the manuscript in a blank that related to the name of the device and the person who purchased the device (e.g., parent, independent school district, grant, insurance, university, not reported). The first author independently located the current price of each SGD utilized in research.

Acceptability data obtained included whether (a) participants/caregivers provided input regarding device choice for intervention (i.e., yes, no), (b) reinforcers were used as part of the intervention (i.e., yes, no), (c) total number of minutes for the intervention (i.e., free or open-ended response where information was provided verbatim from the article in a blank related to the number of minutes the intervention was delivered), (d) amount of time the implementer and child were taught to use the device (i.e., free or open-ended response where information was provided verbatim from the article in a blank), (e) time when stakeholders are taught to use the device for the purposes of the intervention (i.e., pre-intervention, during intervention, not reported), and (f) number of possible uses for the device (i.e., one or more than one.

Feasibility data included an open-ended response where raters provided verbatim information directly from the manuscript in a blank that related to the type of device used prior to intervention, device breakdowns (e.g., not charged, device not available for use, etc.), operation effort, communication rate with device, and device portability. See Table 14 for the Dependent Measures.

The first author created two Google Forms (used to code pre-intervention social validity and post-intervention social validity data), and one Excel spreadsheet (used to

code AAC descriptive data) with choices created using the Data Validation feature. Data are organized in the Results section in accordance with the order of the research questions.

Interrater Reliability

See Ganz et al. (2020) for reliability percentages for the title and abstract, full-text, and methodological quality phases of the comprehensive meta-analysis. For each measure specific to this review, raters attained at least 80% agreement for each category prior to coding independently. The first author served as the primary rater. Three undergraduate students in special education and one post-doctoral student completed interrater reliability for all three categories. Two raters completed reliability for 100% of the articles for pre-intervention and post-intervention coding and 48% of the articles for AAC coding. Reliability was calculated using point-by-point agreement. Disagreements were resolved via discussion. Agreement was 96% for the pre-intervention category, 97% for the post-intervention category, and 85% for the AAC category. See supplementary article-level coded data in OAKTrust.

Results

Social Validity

Overall, 31 (36%) articles recorded no pre-intervention social validity data, 38 (44%) articles reported at least one pre-intervention social validity measure, and 17 (20%) articles reported two or more social validity measures. Concerning post-intervention data, 53 (62%) of articles reported no social validity data, 6 (7%) articles

reported at least one social validity measure, and 27 (31%) reported two or more social validity measures.

Pre-Intervention Subjective Goals

Sixteen of the 86 studies (19%) that met the inclusion criteria for this review described subjective data on the goals implemented prior to the intervention. Refer to Table 15 for Pre-Intervention Subjective and Normative Social Validity Data. In terms of type of subjective feedback, studies primarily included anecdotal feedback and interviews for subjective pre-intervention goals data. Parents/caregivers/group home workers, teachers, and therapists/clinicians provided input for 96% of all information reported on goals prior to the intervention, while the remaining 4% of studies collected information from the child or adult participants.

Pre-Intervention Subjective Procedures

Stakeholders provided subjective input on the instructional procedures in 53 out of 86 (62%) studies (see Table 15). In terms of the type of data collection method, researcher reported the use of interviews and anecdotal feedback most of the time. No studies collected data using standardized assessments or developmental norms such as developmental checklists. Parents/caregivers/group home workers, teachers, and therapists/clincians provided input for 92% of all information reported on procedures prior to the intervention, while the other 8% of the studies collected information from child or adult participants.

Pre-Intervention Subjective Outcomes

Stakeholders provided subjective input on the outcomes in 2 out of 86 (2%) studies (see Table 15). The only collection methods reported were questionnaires/surveys and anecdotal feedback. Teachers and therapists/clinicians provided input for 100% of all information reported on outcomes prior to the intervention.

Pre-Intervention Normative Data Addressing Goals, Procedures, Outcomes

Stakeholders in one study (1%) reported that they had selected participant goals based on developmental norms with respondents as therapists/clinicians (see Table 15). Two studies (2%) reported normative data for procedures from parent/caregiver/group home workers and child or adult participant reports. A small number of studies reported non-validated questionnaires/surveys, interviews, and anecdotal feedback as data collection methods.

Post-Intervention Subjective Goals

Stakeholders in seven (8%) studies reported normative information related to the intervention targets chosen. See Table 16 for Post-Intervention Subjective and Normative Social Validity Data. For the most part, the primary data collection method included questionnaires/surveys obtained primarily from teachers (n = 6).

Post-Intervention Subjective Procedures

31 (36%) studies reported data for subjective procedures information (see Table 16) and researchers collected data using questionnaires/surveys. Regarding from whom data were collected, parents/caregivers/group home workers and teachers provided input

for 63% of all information reported on procedures post-intervention, while respondents for the remaining 37% were adult or child participants, therapists/clinicians, community members, or peers.

Post-Intervention Subjective Outcomes

26 (30%) studies reported subjective outcome data (see Table 16). In regard to the type of data collection method, Researchers reportedly used questionnaires/surveys to collect the data. Parents/caregivers/group home workers and teachers provided input for 64% of all information reported on outcomes post-intervention, while respondents for the remaining 36% were adult or child participants, therapists/clinicians, community members, or peers.

Post-Intervention Normative Goals and Outcomes

Two (2%) studies collected normative data related to the goals and 3 (3%) studies collected normative data on the outcomes (see Table 16). Collection methods included questionnaires/surveys and developmental norms and respondents were primarily parents/caregivers/group home workers and developmental norms. In terms of outcomes data, therapists and clinicians primarily used developmental norms to collect the data.

Affordability, Acceptability, and Feasibility of AAC Data

Affordability

Researchers reportedly used multiple types of SGDs, ranging from dedicated SGDs to applications on a device with multiple uses (e.g., tablet). The first author conducted an online search or attempts to contact the company to obtain the price should

the price of the device not be available in the research article. Approximately half of the devices with available prices were under $250. Applications ranged in price from free to a $349 subscription over three years (mean = $316). Dedicated devices ranged from $15 to $6,595 (mean = $1025). Costs of Apple and Android tablets required to operate apps range from approximately $150 to $800. The prices for nine products could not be located online or by contacting the manufacturer/distributor. Most of the studies did not report the person that purchased the device for the study. All other categories with the exception of the insurance protection category had five or less studies included.

Acceptability

Twelve (14%) studies reportedly gave stakeholders a choice of the SGD used in the intervention and 72 (84%) studies used some aspect of motivation. See Table 17 for AAC Descriptive Coding. Thirteen studies provided sufficient information to estimate implementer AAC teaching time (approximate teaching time range = 22 to 1080 min and approximate teaching time mean = 223 min). Six studies indicated that participants had prior experience with the device and provided enough information to estimate child AAC teaching time (approximate teaching time range = 56 to 900 min and approximate teaching mean = 445 min).

The implementers taught the learner to operate the SGD for the purposes of the intervention prior to the intervention in 28 studies, during the intervention in five studies, and the timing of the AAC teaching was not reported in 53 studies. Learners were taught to operate the SGD for the purposes of the intervention prior to the intervention in six studies, during the intervention in 79 studies, and it was not reported in one

study. Finally, the method the implementers are taught was not reported in most of the studies. Among studies reporting this information, teaching prior to the intervention was the most common type.

Feasibility

Data were also obtained on the types of SGDs that learners used prior to the study (see Table 17). Devices used during the intervention included dedicated SGDs (n = 27) and software on a device with more than one use (n = 57). In regard to reported device breakdowns, most of the studies did not indicate there was a device breakdown during the intervention. Most of the studies reported no information about the effort it took to operate or learn to use the device. Researchers reported that it took more time for participants to use the device to communicate. Most of the studies did not provide any indication that the SGD impacted communication rate.

Information about the portability of communication devices was reported in 12 studies. A range of comments related to the portability of the SGDs were made. McMurray (2016) reported the size of the PECS binder is similar to the iPad, while Lorah et al. (2013) reported the SGD is larger than PECS. Many studies reported the tablet based devices were light weight or portable (Hong et al., 2014; Lorah et al., 2015; Mancil et al., 2016; Nepo et al., 2017; Wendt et al., 2019). One study reported the device that was used during the intervention had a handle to carry it around (Bock et al., 2005).

Comparison of Pre- and Post-Intervention Social Validity Trends Over Time

Pre-Intervention Data

Overall, the number of studies using high-technology SGDs has increased between 1993 and 2020. See Figure 11 for Pre-Intervention Data Depicting Social Validity Trends Over Time and Figure 12 for Post-Intervention Data Depicting Social Validity Trends Over Time. Pre-intervention subjective data for goals indicates there were articles that reported data in 2003 and prior in addition to 2012 and after. Articles reported subjective data for procedures over the years, with no data coded in 1998, 2005, or 2007. Data for subjective outcomes were only reported in 2003 and 2013, whereas normative information related to goals was only reported in 2015. Normative procedures were only reported in 2014 and 2019. No normative outcomes data were reported.

Post-Intervention Data

Post-Intervention subjective data for goals were reported in 2016 and after (see Figure 11 and 12). Data for subjective procedures were variable throughout the years, whereas data for subjective outcomes data were reported in articles in 2007 and after. Stakeholders reported normative goals information in 2019, and normative outcome data were reported in 2013 and after.

Discussion

Social validity is important for stakeholder buy-in, which could ultimately impact the results of the intervention (Fäldt et al., 2020). In this systematic review of single-case studies of interventions using AAC, more subjective than normative data were reported for both pre-intervention and post-intervention. Implementers were primarily taught to

implement the intervention prior to the study, and those with disabilities were taught to use the device during the study.

Approximately half of the SGDs used in the studies were under $250, indicating that there are cost effective options for most price ranges. Regarding acceptability, most of the studies did not solicit input about the device used during the intervention. Elements of motivation such as the provision of reinforcers were incorporated in most of the studies; however, most of the interventions did not report that stakeholders provided input about the device used for the intervention. Those that implemented the intervention were taught to use the AAC device prior to the intervention most of the time. Those that had prior experience with high-technology types of devices may have required less teaching time to operate the device for the purposes of the intervention.

Similar to the results reported by Kennedy (1992), we found an increased use of subjective over normative data. However, in contrast to Kennedy (1992), we found that more subjective data were collected prior to the intervention than after the intervention. It is important to point out that the Kennedy (1992) study reviewed articles between 1968 and 1990, whereas the present article reviewed studies between 1992 and 2020. Fewer studies reported at least one social validity data measure post-intervention compared to pre-intervention. This is surprising given previous reviews of social validity components that reported a greater use of social validity assessments post-intervention when compared with pre-intervention (D'Agostino et al., 2019; Hurley, 2012).

In response to Kennedy's call to create a greater range of social validity assessments, researchers coded the data collection method in this review. Researchers

primarily utilized less formal means of data collection prior to the intervention (e.g. discussions about the research project or a review of individualized education plans), which may allow researchers to tailor the intervention to the individual with a disability. Formal methods of data collection were mostly used post-intervention (e.g., Behavior Intervention Rating Scale (Von Brock & Elliott, 1987)), which may be less subject to bias (Ledford et al., 2016).

Results of this review can be compared to data reviewed by Morin et al. (2017). These investigators examined 17 studies using AAC to enhance the social-communication skills of individuals with complex communication needs. A review of the extended methodological quality of articles meeting basic standards revealed 14 out of 24 studies that met standards with reservations for the social validity component. The authors considered the results of the social validity findings and the impact on the internal validity of the study. If those completing the social validity measures were not satisfied with the intervention goals, outcomes, or procedures, will what was learned continue to be implemented in the future? The same idea applies to the current systematic review and is arguably important given the cost involved in acquiring high-technology AAC devices.

In this review of interventions occurring from 1992 to 2020, more devices with more than one function were used during the intervention. Costs ranged from free applications, dedicated devices under $100, and a number of applications or devices $250 and over, where we also have to take the price of the device itself into consideration. Given the range in prices, one could say that there are currently AAC

device options available for all budgets. One price of particular note is the cost of the dedicated devices on the higher end of the price spectrum. It is no surprise that our review of the literature found more studies used applications on devices with more than one use, thus allowing the child to have access to a means of communication at a lower cost.

Examination of the Use of Subjective and Normative Data Trends Over Time

If the intervention is not appropriate for both the learner and the interventionist, it may not be sustainable. Reporting of more outcome data post-intervention than pre-intervention is unsurprising given interventionists/researchers desire for positive ratings of the intervention.

Given the results of the stakeholder survey, feedback from the individual with a disability can be valuable and it is the right of the individual with a disability to be given the option to provide it (Assembly, 1989). A low-technology choice board can be used to provide a choice of device for the individual with a disability (Bersani, 1999; Krogh & Lindsay, 1999; Romski & Sevcik, 2018). Similar to the results and implications of other studies, use of more normative feedback could provide a response that is less subject to bias than subjective measures (Ledford et al., 2016; Snodgrass et al., 2018).

Limitations and Future Directions

Group design studies were not included in this review of the literature given the differences between single-case designs and group designs in terms of population, interventions, and reporting. Future systematic reviews could focus on or include group design studies. Given the paucity of normative data included in this study, it would be

beneficial to include normative data collection methods that are less subject to bias. Researchers could also thoughtfully consider the reason stakeholders choose one device over another device (e.g., choice of SGD over low-technology device). Attention to the collection of the intricacies of AAC use such as who purchased the device, resources needed to teach stakeholders how to use the SGD, and anecdotal information surrounding device breakdowns may also be useful information for policy and practice (Romski & Sevcik, 2018).

Conclusion

Researchers found reports of more subjective than normative data. Caregivers and clinicians provided the information using questionnaires, surveys, or anecdotal feedback most of the time. Studies reported stakeholders were not given a choice of the device in 86% of the studies and a motivator was reported to be used in 84% of the studies. Implementers were primarily taught to use the device prior to the intervention, whereas children were taught to use the device during the intervention.

Table 14 Dependent Measures

Dependent Measure	Question to Answer	Response Choices
Subjective Input Goals	Are parents, teachers, persons with disabilities, community members, etc. (stakeholders) asked to provide input on the goals/intervention targets?	Yes No
	Who (e.g., parents, teachers, persons with disabilities, community members, etc.) is asked to provide input on the goals/intervention targets?	1=parent/caregiver/group home worker 2=child or adult participant 3=teacher 4=therapist/clinician 5=community member 6=job coach 7=peer 8=developmental norms
	How were parents, teachers, persons with disabilities, community members, etc. (stakeholders) asked to provide input on the goals/intervention targets?	1=questionnaire/survey 2=interview 3=anecdotal feedback 4=standardized assessment 5=developmental norms
Subjective Input Procedures	Are stakeholders asked to provide input about how they usually manage the child's behavior or target communication?	Yes No
	Who (e.g., parents, teachers, persons with disabilities, community members, etc.) is asked to provide input about how they usually manage the child's behavior or target communication?	1=parent/caregiver/group home worker 2=child or adult participant 3=teacher 4=therapist/clinician 5=community member 6=job coach 7=peer 8=developmental norms
	How do stakeholders provide input about how they usually manage the child's behavior or target communication?	1=questionnaire/survey 2=interview 3=anecdotal feedback 4=standardized assessment 5=developmental norms

Table 14 Continued

Dependent Measure	Question to Answer	Response Choices
Subjective Input Outcomes	Are stakeholders asked to provide input about the level of responding (i.e. 80% accuracy, needed to get 3 out of 5 questions correct to move to the next phase/condition) needed to determine if the behavior has been obtained or met criterion?	Yes No
	Who is asked to provide input about the level of responding (i.e. 80% accuracy, needed to get 3 out of 5 questions correct to move to the next phase/condition) needed to determine if the behavior has been obtained or met criterion?	1=parent/caregiver/group home worker 2=child or adult participant 3=teacher 4=therapist/clinician 5=community member 6=job coach 7=peer 8=developmental norms
	How are stakeholders asked to provide input about the level of responding (i.e. 80% accuracy, needed to get 3 out of 5 questions correct to move to the next phase/condition) needed to determine if the behavior has been obtained or met criterion?	1=questionnaire/survey 2=interview 3=anecdotal feedback 4=standardized assessment 5=developmental norms
Normative Input Goals	Do members of the research team look at typically developing individuals to determine what kinds of behaviors are appropriate to teach to children with disabilities?	Yes No
	Who is interviewed to determine what kinds of behaviors are appropriate to teach to children with disabilities?	1=parent/caregiver/group home worker 2=child or adult participant 3=teacher 4=therapist/clinician 5=community member 6=job coach 7=peer 8=developmental norms
	How do members of the research team look at typically developing individuals to determine what kinds of behaviors are appropriate to teach to children with disabilities?	1=questionnaire/survey 2=interview 3=anecdotal feedback 4=standardized assessment 5=developmental norms

Table 14 Continued

Dependent Measure	Question to Answer	Response Choices
Normative Input Procedures	Are a group of stakeholders interviewed to determine what kinds of strategies they usually use to help with communication difficulties or improving behaviors?	Yes No
	Who was interviewed to determine what kinds of strategies they usually use to help with communication difficulties or improving behaviors?	1=parent/caregiver/group home worker 2=child or adult participant 3=teacher 4=therapist/clinician 5=community member 6=job coach 7=peer 8=developmental norms
	How are a group of stakeholders interviewed to determine what kinds of strategies they usually use to help with communication difficulties or improving behaviors?	1=questionnaire/survey 2=interview 3=anecdotal feedback 4=standardized assessment 5=developmental norms
Normative Input Outcomes	Do the authors look at children who are typically developing to determine the responding rate that should be used to say that the child has mastered the goal or objective?	Yes No
	Who (e.g., parents, teachers, persons with disabilities, community members, etc.) is asked to provide input?	1=parent/caregiver/group home worker 2=child or adult participant 3=teacher 4=therapist/clinician 5=community member 6=job coach 7=peer 8=developmental norms
	How are stakeholders asked to provide input about comparisons made between people who do disabilities and those who are typically developing?	1=questionnaire/survey 2=interview 3=anecdotal feedback 4=developmental norms 5=standardized assessment

Table 14 Continued

Dependent Measure	Question to Answer	Response Choices
Motivation	Did the researcher try to motivate the participant in any way? Was a preference assessment completed? Was a reinforcer interview completed? Was anyone asked to fill out a checklist for items that are reinforcing?	Yes No
Person Who Purchased Device	Who purchased or provided the device?	1=Parent 2=Independent School District 3=Grant 4=Insurance 5=University 6=Not provided
Prior Device	What kind of device did the individual with a disability use to communicate prior to the intervention?	Copy and paste the name of the device the child used prior to the intervention.
Intervention Device	What kind of device did the individual with a disability use to communicate during the intervention?	Copy and paste the device name that was used during the intervention.
Implementer Teaching Timing	When was the adult/implementer taught to use the high-technology device?	1=Pre-intervention=During baseline or between baseline and intervention 2=During Intervention=Training occurred while the intervention took place 3=Not reported
Teaching Time	What is an estimation of the total number of minutes of training for the intervention?	Copy and paste information that can be used to calculate the number of minutes. For example, approximate totals could be calculated if the number of months/weeks, times per week, and session length were reported. One month was calculated as 4 weeks.

Table 14 Continued

Dependent Measure	Question to Answer	Response Choices
Implementer Teaching Method	How were the adults/implementers taught to use the device?	1=College Course 2=Certification Course 3=Online course 4=Live training during intervention 5=Live training prior to the intervention 6=Live coaching via video or webinar 7=Not reported
Durability	Did the researchers report that any information was reported related to the durability of the AAC device?	Yes No
Child Teaching Timing	When was the child taught to use the AAC device?	1=Pre-intervention=During baseline or between baseline and intervention 2=During Intervention=Training occurred while the intervention took place 3=Not reported
Breakdown	Did the authors report that the device broke down during the baseline, intervention, generalization, or maintenance phases?	Yes No
Number of Uses	How many ways can the device be used?	1=Dedicated AAC and can only be used for communication 2=More than one use
Operation Effort	Did the authors report any difficulty with teaching the participant to communicate using the device?	Copy and paste descriptions from the text.
Rate	Did the authors report that the individual with a disability's communication rate (e.g., person with a disability spoke faster or slower as a result of the device) changed as a result of AAC use?	Yes No
Portable	Did the authors report any information regarding how easy it was to transport the device? What was the weight or size?	Copy and paste descriptions from the text.

Table 14 Continued

Dependent Measure	Question to Answer	Response Choices
Device Choice	Were implementers/children offered multiple choices in terms of devices that were used during the intervention? Was input provided by other stakeholders not involved in the intervention as to what device that was used during the intervention?	Yes No

Table 15 Pre-Intervention Subjective and Normative Social Validity Data

Data Collected	Subjective Data			Normative Data		
Number of Studies	Goals N = 16 (M = 70)	Procedures N = 53 (M = 33)	Outcomes N = 2 (M = 84)	Goals N = 1 (M = 85)	Procedures N = 2 (M = 84)	Outcomes N = 0 (M = 86)
Respondent						
Parent/caregiver/group home worker	7	22	0	0	1	0
Child or adult participant	1	6	0	0	1	0
Teacher	10	28	1	0	0	0
Therapist/clinician	8	19	2	1	0	0
Community member	0	0	0	0	0	0
Job coach	0	0	0	0	0	0
Peer	0	0	0	0	0	0
Collection Method						
Questionnaire/Survey	2	9	1	0	1	0
Interview	7	14	0	0	1	0
Anecdotal Feedback	11	39	1	0	2	0
Standardized Assessment	0	0	0	0	0	0
Developmental Norms	0	0	0	1	0	0

Note. N = Number of studies. M = The number of articles that did not report information for a given category.

Table 16 Post-Intervention Subjective and Normative Social Validity Data

Data Collected	Subjective Data			Normative Data	
	Goals	Procedures	Outcomes	Goals	Outcomes
Number of Studies	N = 7 (M = 79)	N = 31 (M = 55)	N = 26 (M = 60)	N = 2 (M = 84)	N = 3 (M = 83)
Respondent					
Parent/Caregiver/Group Home Worker	3	14	10	1	0
Child or Adult Participant	2	8	5	0	0
Teacher	6	21	19	0	0
Therapist/Clinician	3	6	7	0	1
Community Member	0	1	1	0	0
Job Coach	0	0	0	0	0
Peer	1	5	3	0	0
Developmental Norms	0	0	0	1	2
Collection Method					
Questionnaire/Survey	5	27	21	1	0
Interview	1	2	2	0	0
Anecdotal Feedback	1	4	6	0	1
Standardized Assessment	0	0	0	0	0
Developmental Norms	0	0	0	1	2

Table 17 AAC Descriptive Coding

Characteristics	N	Characteristics	N	Characteristics	N	Characteristics	N
Motivation		Device Purchasee		Implementer Teaching Timing		Implementer Teaching Method	
Yes	72	Parent	3	Pre-intervention	28	College course	1
No	14	ISD	4	During intervention	5	Certification course	1
		Grant	5	Not reported	53	Online course	0
Durability		Insurance	0			Live coaching during IV	3
Yes	11	University	3	Child Teaching Timing		Live coaching prior to IV	23
No	75	Not reported	71	Pre-intervention	6	Coaching via video/webinar	1
				During intervention	79	Not reported	57
Number Device Uses		Device Breakdown		Not reported	1		
One	27	Yes	6			Stakeholder Device Choice	
More than one	57	No	80	Change in Communication Rate		Yes	12
Not reported	2			Yes	3	No	74
				No	83		

Note. N = number of studies, ISD = Independent School District, and IV = Intervention.

Figure 11 Pre-Intervention Data Depicting Social Validity Trends Over Time

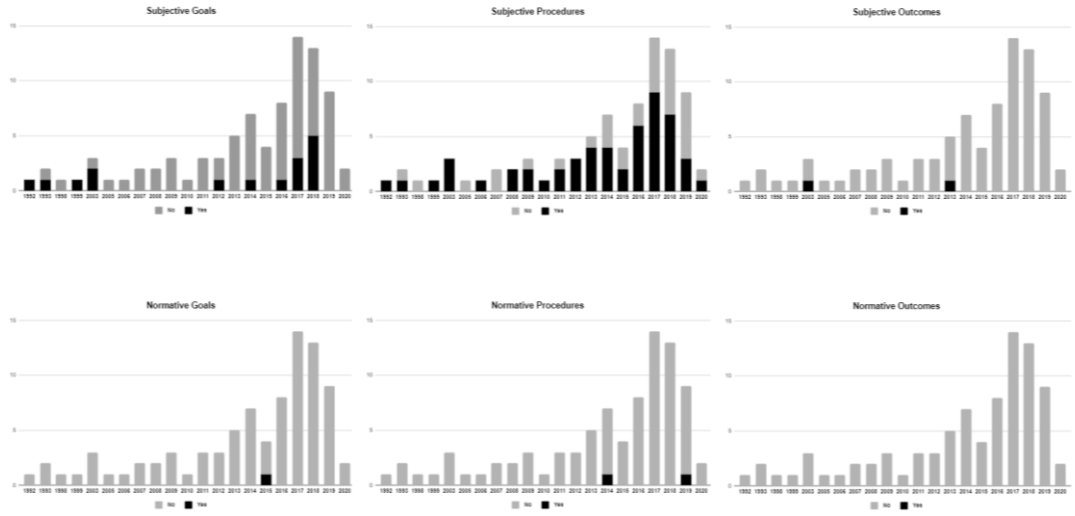
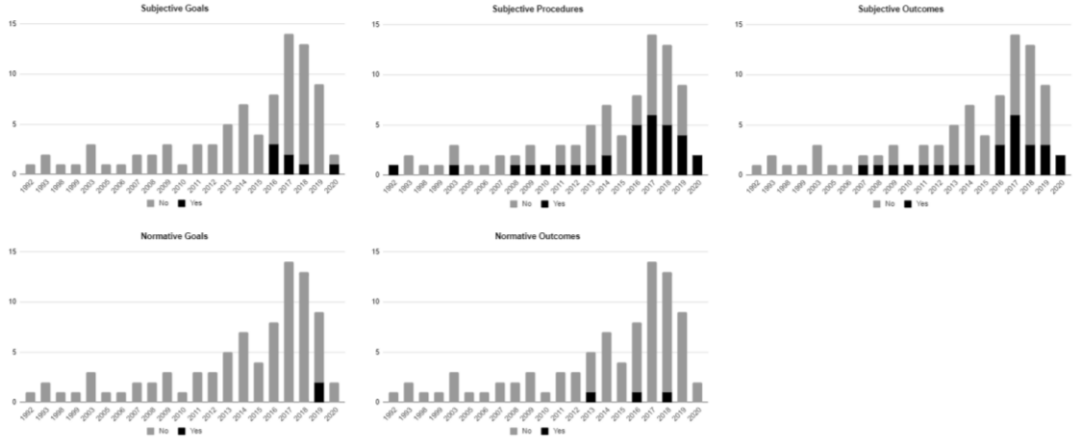


Figure 12 Post-Intervention Data Depicting Social Validity Trends Over Time



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CHAPTER V

SUMMARY AND CONCLUSIONS

This work is comprised of a single-case experimental design exploring a modified dialogic reading intervention, meta-analysis and systematic review of literature related to storybook reading interventions for individuals with ASD/ID and physical disabilities, and a systematic review of social validity, affordability, acceptability, and feasibility of augmentative and alternative communication (AAC) devices used for individuals with ASD and ID. A summary of each study, limitations, and future directions are provided.

Chapter II of this dissertation included a multiple-probe across participants design that explored the impact of the parent's ability to implement a modified dialogic reading intervention where instruction was provided via telepractice and individuals received coaching sessions where they were given feedback about their performance. A single-case experimental design was used and a functional relation between parent training via telepractice and the implementation of the independent variable was indicated. Due to the complexity of the intervention and the variability of the data, it was difficult to conclude that parent implementation of the modified dialogic reading intervention had an impact on the participant's ability to answer comprehension questions.

Chapter III of this dissertation detailed a systematic review and meta-analysis of studies using storybook interventions for individuals with ASD/ID and physical

disabilities. The studies included mostly participants ages 6-10;11 and English Language Learners as participants were not widely reported. A one-to-one intervention format and settings in classrooms were frequently reported. The omnibus effect size for ASD/ID studies revealed moderate effects. The omnibus effect size for physical disability studies was large. Factor level effects revealed a statistically significant difference in communication outcomes across moderators, with the exception of the use of high-technology devices for individuals with physical disabilities.

Chapter IV of this dissertation was a systematic review of factors related to social validity, affordability, acceptability, and feasibility of AAC interventions. Work of Kennedy (1992) was expanded for this review. More subjective than normative data were reported for both pre-intervention and post-intervention time periods. Implementers were primarily taught to implement the intervention prior to the study, and those with disabilities were taught to use the device during the study. A range of device cost options for AAC were found for all budgets.

Implications

Implications for practice are evident as a result of these three studies. Parents can be taught to implement interventions to their children via telepractice delivery methods. This allows more individuals to receive services in geographical locations in which service providers or meeting locations may be limited and individuals with disabilities are at a disadvantage. While results of the systematic review and meta-analysis should be interpreted with caution due to the low number of studies included, storybook reading interventions for individuals with ASD/ID and physical disabilities that use AAC may be

a good option to teach a variety of communication skills. In reference to the systematic review of studies where participants used AAC, a number of device options are available to individuals who require another means of communication.

Limitations

There are limitations to all three studies included in this dissertation. For Chapter II, due to a technology malfunction, there were no training fidelity data collected in baseline for one parent and books were preselected without consideration for child and parent preferences. In regard to Chapter III, few studies met the inclusion criteria and there was low inter-observer agreement for some variables. For Chapter IV, group design studies were not included in the review of the literature. Resources needed to teach stakeholders how to use the SGD and more anecdotal information surrounding device breakdowns were not coded in the review.

Future Directions

There are several directions for future research were found as a result of this dissertation. In regard to the single-case experimental design study, high-technology devices can be used for communication and books targeting social skills could be used as a natural context for discussion. The systematic review and meta-analysis found that future work that included studies of individuals with ASD that targeted a variety of skills would be beneficial. Future studies could also explore the use of a variety of settings for intervention. Finally, future studies could investigate group designs and use more normative data to make decisions.

APPENDIX A

MODERATOR VARIABLES

Study	Book Type	AAC	Wait Time	Frontloading
Alison (2017)	Adapted paperback book	High	Yes	No
Boyle (2018)	Book programmed on an app	High	Yes	No
Browder (2007)	Adapted paperback book	Combination	Yes	Yes
Browder (2011)	Adapted paperback book	Combination	Yes	Yes
Browder (2013)	Adapted paperback book	Low	Yes	No
Courtade (2013)	Paperback	Low	Yes	Yes
Dexter (1998)	Paperback	Low	Yes	No
Finke (2017)	Paperback	High	Yes	Yes
Golloher (2015)	Adapted paperback book	Low	Yes	Yes
Golloher (2018)	Adapted paperback book	Combination	Yes	Yes
Hudson (2012)	Adapted paperback book	Low	Yes	Yes
Kemper (2012)	Adapted paperback book	Combination	Yes	Yes
Kent-Walsh (2010)	Paperback	Combination	Yes	No
Lee (2012)	Combination	Combination	Yes	No
Lorah (2017)	Paperback	High	Yes	No
Mandak (2019)	Book programmed on an app	High	Yes	Yes
Mims (2009b)	Adapted paperback book	Low	Yes	No
Na (2015)	Paperback	Low	Yes	No
Nasir-Tucktuck (1998)	Adapted paperback book	Low	Yes	No
Pitman (2015)	Paperback	High	Yes	No
Roberts (2013)	Adapted paperback book	Combination	No	Yes
Sennott (2013)	Paperback	High	Yes	No
Spooner (2008)	Adapted paperback book	High	Yes	Yes
Spooner (2009)	Adapted paperback book	Low	Yes	Yes
Spooner (2014)	Adapted paperback book	High	Yes	Yes
Stephenson (2009)	Paperback	Low	Yes	No
Su (2019)	Paperback	Low	Yes	No

Appendix A Continued

Study	Book Type	AAC	Wait Time	Frontloading
Therrien (2018)	Paperback	High	Yes	No
Whalon (2015)	Adapted paperback book	Low	Yes	No
Whalon (2016)	Paperback	Low	Yes	No
Yorke (2018)	Paperback	Low	Yes	Yes

APPENDIX B

PHYSICAL DISABILITY MODERATOR VARIABLES

Study	Book Type	AAC	Wait Time	Frontloading
Browder (2007)	Adapted paperback book	Combination	Yes	Yes
Browder (2007)	Adapted paperback book	Combination	Yes	Yes
Browder (2008)	Adapted paperback book	Combination	Yes	Yes
Browder (2011)	Adapted paperback book	Low	Yes	Yes
Browder (2011)	Adapted paperback book	Low	Yes	Yes
Edmister (2015)	Paperback	High	Yes	Yes
Ho (2000)	Paperback	Low	Yes	No
Hudson (2012)	Adapted paperback book	Low	Yes	Yes
Kent-Walsh (2010)	Paperback	Combination	Yes	No
Kent-Walsh (2010)	Paperback	Combination	Yes	No
Lee (2012)	Combination	Combination	Yes	No
Mims (2009a)	Adapted paperback book	Low	Yes	No
Roberts (2013)	Adapted paperback book	Combination	No	Yes
Roberts (2013)	Adapted paperback book	Combination	No	Yes
Rodrigues (2016)	Paperback	Low	Yes	No
Spooner (2008)	Adapted paperback book	High	Yes	Yes
Spooner (2008)	Adapted paperback book	High	Yes	Yes
Stephenson (2009)	Paperback	Low	Yes	No

APPENDIX C

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