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THE EFFECTS OF AAC VIDEO VISUAL SCENE DISPLAY TECHNOLOGY ON THE COMMUNICATION OF PRESCHOOLERS WITH AUTISM SPECTRUM DISORDER

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ABSTRACT

Although most young children develop language and have access to the benefits of communication, many children with autism spectrum disorder (ASD) either experience delayed development, or do not develop at all, the speech needed to meet their daily communication needs. Although augmentative and alternative communication (AAC) can be of benefit, systems based on symbols and grid layouts can be challenging for very young children. An AAC video visual scene display approach uses an AAC app (provided on a tablet computer), and videos based on the interests of the child, to provide opportunities for communication and social interaction between the child and the communication partner. The purpose of this study was to investigate the impact of video visual scene display technology on the symbolic communicative turns taken by preschoolers with ASD and complex communication needs during a high-interest, shared activity.

Keywords: preschoolers, autism spectrum disorder, augmentative and alternative communication, social interaction

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Chapter 1

Introduction

Many children with autism spectrum disorder (ASD) have *complex communication needs*, meaning speech alone does not meet their daily communication needs (Beukelman & Mirenda, 2013). By age nine, 48% of children with ASD either have no or few spoken words, or speak using words but not sentences (Anderson et al., 2007). In part because of these communication challenges, children with ASD typically do not respond to or initiate social interaction at the same rate as their typically developing peers and have only limited participation in key educational and social opportunities (National Research Council [NRC], 2001). Without effective intervention, these individuals will enter adulthood without an effective means of communication, and face reduced outcomes in social interaction, employment, and community participation (Light, McNaughton, Beukelman et al., 2019).

Augmentative and Alternative Communication (AAC)

There is evidence that use of augmentative and alternative communication (AAC) technologies, such as the use of low tech AAC displays and high tech AAC speech generating devices, can benefit the communication of children with ASD and complex communication needs (Ganz, 2015; Tan & Alant, 2018). To date, however, most interventions for children with ASD have emphasized the use of AAC to request desired items (Morin et al., 2018), rather than to engage in social interaction with a communication partner.

Social Communication, ASD, & AAC

While the fulfillment of needs and wants is an important aspect of communication, participation in social interaction routines (e.g., communicating while reading a book with a partner, or playing a game) is critical to early communication and language development. It is through these social interactions that foundational communication skills such as joint attention (i.e., looking at the same item as the communication partner) and turn-taking (i.e., recognizing that there is an opportunity to take a communicative turn) are learned. Young children with ASD often demonstrate limited participation in social interaction routines (Mundy & Sigman, 2015); as a result, these critical early communication skills are often delayed or absent (Ganz, 2015).

Children with ASD may struggle to communicate within social interaction routines for at least four reasons (Light, McNaughton, & Caron, 2019; Caron, Laubscher, Light, & McNaughton, 2019). First, young children with ASD are more likely to fail to "take a turn" within a social interaction, in part because they may not attend to or recognize interaction cues from communication partners (Mundy & Sigman, 2015). Failure to take turns not only results in a missed opportunity to practice the use of a communication skill, but also can lead to a communication breakdown and the end of the social interaction if the communication partner does not "repair" the interaction.

Second, although traditional AAC systems can be used to engage in social interaction activities (Holyfield, Drager, Kremkow, & Light, 2017; Trottier, Kamp, & Mirenda, 2011), the use of these AAC systems by beginning communicators requires the child to attend to three different elements: the social interaction activity (e.g., the picture book or game), the communication partner, and the AAC display. The challenge for the child to allocate and coordinate attention between these three different elements often leads to communication breakdowns (McCarthy, Broach, & Benigno, 2016), including a failure to recognize and take communicative turns during interactions (Light & Drager, 2007; Light et al., 2004).

Third, the AAC representational system (i.e., the symbols used) may pose another barrier to communication. There is research evidence that beginning communicators struggle to learn the decontextualized images commonly used in symbol systems, and that the vocabulary representations provided by many symbol systems may be a poor match for how children conceptualize the target word (Light, Wilkinson, Thiessen, Beukelman, & Fager, 2019; Worah, McNaughton, Light, & Benedek-Wood, 2015).

Finally, the AAC system may lack personally relevant vocabulary. Often AAC systems for beginning communicators have only a small number of vocabulary concepts focusing on needs and wants (Beukelman & Mirenda, 2013). In contrast, Light and Drager (2007) suggested that AAC systems should support children in learning a wide variety of vocabulary concepts, driven (as in typical language development) by the interests of the child. The reliance on the small amount of vocabulary typically made available in AAC systems may fail to assist children with complex communication needs in communicating about their specific areas of interest, thus impacting the child's motivation to communicate.

Visual Scene Display Technology

As an alternative to traditional AAC approaches with beginning communicators, the use of *visual scene displays (VSDs)* has been suggested (Light & McNaughton, 2012). In a VSD approach, images (typically photos) on a tablet computer are programmed with vocabulary hotspots; when touched, the hotspot produced speech output. Figure 1 shows an example of a VSD using an image of a construction site.

The use of VSDs has been observed to result in positive changes in both the number of turns taken and the number of different vocabulary items used by children and adults with developmental delays during social interaction routines (Light, McNaughton, Beukelman et al., 2019; Light, McNaughton, & Caron, 2019). The contextual support provided by the photographic image appears to play an important role in supporting the effective use of the AAC system (Light, Wilkinson et al., 2019).

Video VSD Technology

As an extension of a VSD approach, Light, McNaughton, and Jakobs (2014) proposed the use of *video visual scene displays* (video VSDs). In a video VSD intervention, the communication partner captures videos of preferred activities, including authentic real-life experiences (i.e. the child at a birthday party) or interests (i.e. YouTube videos), pauses the video at key junctures to automatically create a VSD (Figure 1), and adds vocabulary as hotspots (with speech or text output when activated) to support communication (Light, McNaughton, & Caron, 2019). As Light et al. (2014) hypothesized,

> VSDs embedded within a video will be even more effective at facilitating participation and communication than static photo VSDs because video VSDs capture *both* the spatial and temporal contexts of activities and communication opportunities, thereby preserving the *dynamic* relationships and engagement cues found in real world interactions…Automatic pausing of the video at key segues in the event marks the appropriate opportunity for participation and communication, and provides the necessary vocabulary within the VSD for the individual who uses AAC to fulfill the communication demands at that point.

Video VSDs to Support Children with ASD

A video VSD approach not only provides strong contextual support for communication – it also allows the use of preferred videos for the child with ASD. Children with ASD engage with electronic screen media, including videos, more often than all other leisure activities (Mazurek & Wenstrup, 2013). Although parents often report that their children pay strong attention to favorite videos, typically this is an isolated activity for the child (Shane & Albert, 2008). The use of video VSDs introduces communication and interaction into what was previously a solitary activity for the child.

Caron et al (2019) investigated the use of video VSDs as a means to increase social interaction and communication for five older children and adolescents (aged 10-18 yrs. old) with moderate-to-severe ASD and limited speech. The video VSD intervention, implemented using preferred videos of the participants, resulted in increases in communication turns (Tau U of .93-1.00) for all participants. Caron, Holyfield, Light and McNaughton (2018) also reported positive outcomes in using a video VSD approach with a child (aged 9 yrs. old) with ASD by embedding videos captured from the child's daily leisure experiences at school (e.g., riding a bike) to allow the child opportunities for communication about his school day with a communication partner.

Goals of the Present Study

To date, the use of a video VSD approach to support social interaction with an adult partner has only been investigated with school-aged children, adolescents, and young adults with ASD and other developmental disabilities. The purpose of this study, therefore, was to investigate the question: What is the effect of using AAC video VSD technology on the frequency of communicative turns taken by young children (aged 3-5) with ASD and complex communication needs during a shared activity?

Chapter 2

Method

Research Design

This study used a multiple-probe design (Horner & Baer, 1978) across three participants. The independent variable was the use of the video VSD application while viewing a preferred video on a tablet computer; the dependent variable was the number of symbolic communicative turns taken by the child while viewing the video on the tablet.

The participants remained in the baseline condition until there were at least five baseline probes for each participant. The independent variable was then introduced to the first participant who demonstrated a stable baseline (Gast, 2010; Kennedy, 2005; Kratochwill et al., 2010). The independent variable was subsequently introduced to the second participant when the first participant demonstrated a treatment effect. A *treatment effect* was defined as an increase (from the highest number of turns observed at baseline) of at least two symbolic communicative turns for two consecutive intervention sessions. A multiple-probe research design was chosen to minimize the boredom and fatigue that may have occurred with a multiple baseline design (Binger & Light, 2007; McReynolds & Kearns, 1983; Tawney & Gast, 1984).

Participants

The study took place at an early childhood education (ECE) program that provided services to both children with and without disabilities. The study was approved by the Institutional Review Board of The Pennsylvania State University's Office for Research Protections. Informed written consent was obtained from the parents of all participants.

Participants met the following selection criteria: (a) were between the ages of 3;0 and 5;11; (b) had a diagnosis of autism spectrum disorder provided by a licensed psychologist; (c) had minimal speech and did not demonstrate speech skills adequate to meet their daily communication needs, as reported by teacher and parent and through researcher observation; (d) were identified by parents as showing high interest in watching shows on television or computer at home; (e) demonstrated the ability to follow simple one-step directions in context (e.g. “sit in chair”); (f) demonstrated hearing and vision within or corrected to be within normal limits); (g) lived in homes in which English was the first language.

Children participated in a final screening task, designed to assess the child’s ability to access a tablet computer, to determine eligibility for the study. The researcher programmed a preferred and popular early childhood game on a tablet computer. The game included “hotspots” shaped as animals. The researcher modeled how to touch the animal several times while commenting on animal and prompted the child to do so. If the child was able to activate an animal sound output by touching the animal “hotspot” at least three times, they were eligible for participation in the study.

Three young children with ASD and complex communication needs met the selection criteria and participated in this study. Matthew, Bella, and Noah were 3 years 11 months, 4 years 11 months, and 5 years 6 months at the beginning of the study. All three participants received early childhood special education services within specialized classrooms for children with ASD, developmental delays, and other disabilities.

Matthew received a diagnosis of ASD when he was 2 years 3 months old. When provided with an opportunity to select a preferred activity, Matthew chose playing on a tablet computer, playing with water, and watching a show on the computer. According to parent report, Matthew spent approximately 3-5 hours a day watching television, or playing games on a computer.

Matthew's teacher reported that he did not use natural speech to communicate, although he did use vocalizations (with appropriate prosody) and facial expressions to indicate when he was happy or angry. Matthew made use of gestures (e.g. pointing at/towards or leading a grown-up to desired activity/item), a sign approximation for "more", and was learning to use Picture Exchange Communication System (Bondy & Frost, 1994, 2001; Frost & Bondy, 1994, 2002) line drawings to request desired items. Matthew typically would independently obtain desired items instead of initiating interaction to obtain the item. He did not typically communicate to express social closeness, share information, or participate in social etiquette routines (though he was beginning to wave "goodbye" and "hello" to the researcher).

According to Matthew's speech-language pathologist, he did not respond to his name, engage in joint attention, or make intentional eye contact. Based on observations conducted with the Communication Matrix (Rowland, 2003; Rowland, 2011) by his speech language pathologist, Matthew had mastered Level 3 (unconventional communicator) and was identified to be an emerging conventional communicator (Level 4). His total score was 58 (out of a total of 160). Matthew mostly communicated to express his wants and needs.

Bella received a diagnosis of ASD when she was 2 years old. When provided with the opportunity to select a preferred activity, Bella would often choose to dress up in princess costumes, look at herself in the mirror, or build with blocks. Bella's parents reported that she spent approximately 3-4 hours a day watching television or playing games on a computer.

Bella's natural speech, as reported by her teacher, was limited to one-word phrases. Occasionally, she would spontaneously use natural speech to express a want or need (e.g., "juice", "fish"). Bella used natural speech in imitating (echoic) what was said to her. Bella also used gestures (e.g., pointing or guiding an adult to a desired item/activity) and imitated sign language (e.g. colors, animals, food, morning circle words) during the day at school. Bella used facial expressions and pressed her face onto another person's face (peer or teacher) to indicate happiness or satisfaction. Bella used sign language (e.g., "thank you") or natural speech (e.g., "bye") within some social etiquette routines. Her teacher reported that she did not typically communicate to express social closeness (except for pressing her face on others) and most frequently communicated to express her wants and needs.

Reports by Bella's speech-language pathologist revealed that Bella was not able to complete receptive or expressive language tasks and due to her limited expressive vocabulary and attention span, her speech articulation could not be assessed. Based on observations by her speech language pathologist, conducted with the Communication Matrix (Rowland, 2003; Rowland, 2011), Bella had mastered Level 3 (unconventional communicator) and was identified to be an emerging conventional communicator (Level 4). Her total score was 56 (out of a total of 160).

Noah received a diagnosis of ASD when he was 2 years 10 months old. When given an opportunity to select an activity, Noah would often choose to lay or jump on the trampoline, chew on his sensory necklace, or climb on the playground equipment. According to parent report, Noah spent approximately 3-5 hours a day watching television or playing games on a computer.

The methods of communication most commonly used by Noah at the early childhood center included smiling when happy or excited, touching a teacher's arm or hand to express wants and needs, gestures (e.g., touching item desired, holding adult's hand and guiding their hand to want/need), and crying/loud vocalizations when frustrated. Noah was observed using many vowel-consonant sounds (e.g., "um") and consonant-vowel sounds (e.g., "bee). Noah did not use natural speech to communicate but often would look directly at his communication partner when something was being said.

The speech-language pathologist who provided speech and language support to Noah within the early childhood program setting completed the Communication Matrix (Rowland, 2003; Rowland, 2011) for Noah. According to the results, Noah mastered Level 2 (intentional communicator) and was identified to be an emerging unconventional communicator (Level 3). His total score was 29 (out of a total of 160). It was reported by his teacher that he mostly communicated to express wants and needs.

Materials

A Samsung Pro Tablet, Model SM-T900 (Samsung, https://www.samsung.com) was used in this research study. For each child, a total of eight videos were created using television shows identified by the child's parents, and spliced to have a run time of five minutes per video. The researcher developed an individualized set of eight videos for each child to view during the research activities based on the child's interests.

Interactive video VSD application. The EasyVSD software app (InvoTek, http://www.invotek.org/) was used to program the videos with embedded hotspots; upon hotspot activation, speech output occurred to provide the message programmed for the hotspot.

A VSD was created every 30 seconds in the videos, so each 5-minute video contained 10 VSDs. Each VSD had two to four hotspots, depending on the number of salient images in the VSD. To identify hotspots, the researcher selected a character (e.g. Happy Dog), place (e.g. bathtub), or thing (e.g. crane) in the VSD that could be labeled with one or two words. Each video contained an average of 30 vocabulary items (range = 20 - 40). Some vocabulary items (i.e. character names) were used more than once in a single video. Figure 2 provides a list of the vocabulary used in a video VSD created for a video depicting construction site equipment. Some vocabulary items also were repeated across videos (e.g., more than one video used the vocabulary item “bulldozer”). In summary, Bella and Matthew were exposed to 240 hotspots (vocabulary items) across eight videos in intervention, while Noah was exposed to 150 hotspots (vocabulary items) across five videos in intervention. Noah viewed fewer videos due to time constraints related to program attendance, and the ending of the summer program.

Dependent Variable

The primary dependent variable in this study was the number of symbolic communicative turns (adapted from Light, Collier, & Parnes, 1985; Binger & Light, 2007; Therrien & Light, 2018) taken by the child with ASD during interactions around a 5-minute long video with the researcher (or generalization partner). To be coded as a *symbolic communicative turn*, the child’s behavior needed to meet both of the following conditions:

(a) the participant’s use of recognizable speech (either speech approximations or through speech output from the AAC app), or conventional signs (to be coded as recognizable, the speech or sign had to be recognized by two raters when viewing the videotape;

(b) the participant’s use of eye contact with the communication partner, body orientation directed towards the communication partner, or movement toward the communication partner.

Procedure

The participants in this study met with the researcher two to three times a week. The researcher was a certified special education teacher with 4 years’ experience in providing early childhood special education instruction to young children with ASD. She completed this study as her dissertation project in her doctoral program in special education. The generalization partner was also a certified special education teacher, with seven years of experience with children with autism and a doctoral candidate in special education.

Each of the eight videos was randomly assigned to baseline, intervention, and generalization conditions, with the provision that no single video would be used more than once in a phase unless all other videos had already been viewed. For example, Matthew viewed five videos of his favorite popular children's shows (i.e., Calliou, Sesame Street 2, Little Einstein's 1, Little Einstein's 2, and Paw Patrol 1) during baseline, and ten videos (i.e., all videos viewed in baseline, as well as Sesame Street 1, Paw Patrol 2 [twice], and Daniel Tiger [twice]), during intervention. The hotspots and VSDs were not viewable during the baseline phase, the hotspots and VSDs were available during the intervention and generalization conditions.

Two video cameras were set up in the room to create video recordings of the communication behavior of both the child and researcher. This provided a permanent product that was used for data collection, procedural integrity, and inter-observer agreement procedures.

Baseline. Each child participated in at least five video-viewing sessions with the researcher during baseline. During baseline sessions, the child sat in a child-sized chair with the researcher sitting directly in front of the child, on the floor. The researcher held the Samsung tablet within 5 inches of her face (either beside her cheek or under her chin) and within arm's length of the child. The researcher also wore one earbud with a timer countdown playing continuously during the session to indicate every 30 seconds of video. Unlike intervention sessions, the videos were played using the video player app on the Samsung tablet (i.e., without EasyVSD technology). Upon every 30-second interval (the time when the researcher would comment (baseline) or the VSD would appear (intervention), the researcher pointed to an image within the video (on the screen of the tablet), and stated "I see a _, what do you see?" (Caron et al., 2019). The researcher then looked at the child and provided an expectant pause for 5 seconds to allow an opportunity for the child to respond. If the child took a symbolic communicative turn during baseline, the researcher responded with a brief expansion (Binger, Kent-Walsh, Ewing, & Taylor, 2010; Cress & Marvin, 2003; Douglas et al., 2013) based upon the child's message. For example, if the child pointed to the image of the bulldozer and said "digger", the researcher would say, "The digger is yellow." The video played without pausing, with the researcher pointing and commenting at 30 - second intervals.

Intervention. Intervention followed the same procedures as baseline except that the hotspots were available in the video VSD app and appeared every 30 seconds. Upon a VSD appearing within the video (every 30 seconds), the researcher stated "I see a _ (activated hotspot), what do you see?" while activating one hotspot on the screen of the tablet. The researcher looked at the child, and provided an expectant pause of at least 5 seconds to allow for an opportunity for the child to take a symbolic communicative turn. If the child did not take a turn, the researcher said, "Let's watch" and pressed play to continue the video clip. If the child did take a symbolic communicative turn, the researcher provided an expansion to comment on the child's communicative behavior (e.g., child activates "glasses" and researcher comments "the glasses are green"). The researcher then provided a 5-second pause to allow the child a second opportunity to take a symbolic communicative turn. If the child took a turn, the researcher expanded on the child's message; if the child did not take a turn after 5 seconds, the researcher stated, "Let's watch" and played the video.

Generalization. Generalization probes occurred during baseline and intervention sessions to investigate the participants' use of the video VSD technology with a new communication partner. The generalization partner was trained in the baseline and intervention procedures through role-play scenarios, direct instruction (model, guided practice, independent practice), and use of a visual checklist of procedures provided by the researcher. Before participating in generalization sessions with the children, the generalization partner demonstrated 100% fidelity of implementation with baseline and intervention procedures across two role-play scenarios.

Social validity. At the end of the study, after the intervention was completed, four early childhood special education (ECSE) professionals, (two specialized classroom teachers, one occupational therapist (OT), one classroom paraeducator) who worked daily with the participants, viewed short video clips (1 minute each) of a participant during a baseline session and during an intervention session. The clips were randomly selected from the pool of both baseline and intervention sessions, per participant. Then, each ECSE professional completed a brief Social Validity questionnaire to record their perceptions of the intervention on the communication of the children with ASD and the perceived acceptability of the intervention within the early childhood setting (Benedek-Wood, McNaughton, & Light, 2016; Schlosser, 1999; Therrien & Light, 2018).

Data Analysis

All sessions were videotaped to ensure the accuracy and consistency of both procedural integrity and data scoring. A research assistant (a graduate student in the special education program) was trained to perform both procedural integrity and data scoring across all phases of the research study. To calculate procedural integrity, both the researcher and the trained research assistant used an integrity checklist that provided a summary of the steps in each phase of the study and data collection to check randomly selected sessions, including 20% of baseline and intervention sessions, and 50% of generalization sessions per participant. The percentage of baseline steps, intervention steps, and generalization steps completed correctly equaled 100%, 97%, and 94% respectively.

For inter-observer agreement, ten 30-second-intervals were coded for each of the selected videos. To calculate inter-observer agreement, a point-by-point agreement ratio was used (the number of agreements was divided by the total number of agreements and disagreements and multiplied by 100). Inter-observer agreement averaged 90.8% across all phases of the study, including baseline (average= 100%), intervention (average= 86.4%), and generalization (average=86.1%) sessions.

Dependent variable data were graphed and analyzed visually for trend, level, variability and slope (Gast, 2010) to determine the effect of the intervention on the number of symbolic communicative turns taken by the children with ASD. Data were also analyzed using Tau U (Lee & Cherney, 2018; Parker, Vannest, Davis, & Sauber, 2011). Tau-U provides a quantitative approach for analyzing single-case experimental design data, and is a measure of data nonoverlap between baseline and intervention phases (i.e., A and B), not including generalization data. Tau-U effect sizes were interpreted as follows: <0.5 minimal to no effect, 0.5–0.69 moderate effect, and 0.7–1.0 a large effect.

Chapter 3

Results

All three participants demonstrated an increase in the number of symbolic communicative turns (Tau U of .92-1.00 across participants, a large effect) taken while viewing a preferred video clip with the researcher and with the generalization partner (Figure 3). The three participants took very few turns (range = 0-1) during the baseline sessions (two of the participants took no turns at all). During intervention, all three participants demonstrated an increase (range = 1- 46) in the number of symbolic communicative turns taken while viewing a preferred video clip with the video VSD technology.

For all three participants, all intervention data points were above the highest point seen in baseline. Due to time limitations associated with the early childhood special education program, the three children varied in the number of intervention sessions received. All children participated in two generalization sessions within intervention, and all generalization data points were above the highest level seen in the baseline generalization for all three of the participants.

Matthew

Matthew participated in five baseline sessions, 10 intervention sessions, and a total of four generalization sessions (two baseline and two intervention) over 3 months. Matthew engaged in zero symbolic communicative turns during baseline and pre-intervention generalization sessions. Matthew demonstrated some variation in performance in the first seven intervention sessions (range = 11-17 turns) although all sessions were higher than baseline performance. During his final three sessions, Matthew demonstrated improving performance (with scores of 24, 34, and 46 respectively for sessions 8, 9, and 10). Matthew took 24 and 34 turns with the generalization communication partner. Using Tau U, a strong intervention effect of 1.0 was calculated for Matthew.

Bella

Bella participated in 10 baseline, 10 intervention, and a total of four generalization sessions (two baseline and two intervention) over a period of 3 months. Bella took zero or one communicative turns during baseline and pre-intervention generalization. Bella demonstrated an increase in number of turns taken in the first session (n=14) in which the intervention was introduced. She also demonstrated treatment effect (i.e. an increase of at least two symbolic communicative turns more than the highest number of turns observed at baseline for two consecutive intervention sessions) after two intervention sessions. Bella demonstrated some variation in performance in the all intervention sessions (range = 5-20 turns) although all sessions were higher than baseline performance. During her final intervention session, Bella demonstrated her highest number of communicative turns (n=23). With the generalization partner, Bella took 13 and 14 communicative turns. When reviewing Bella's performance beginning session 7, it is important to take into consideration that there was a 12-day lapse between sessions 6 and 7, due to Bella being away with her family on vacation. Using Tau U, a strong intervention effect of 1.0 was calculated for Bella.

Noah

Noah participated in 11 baseline, five intervention, and a total of four generalization sessions (two baseline and two intervention) over a period of four months. Noah took zero communicative turns during both baseline and pre-intervention generalization sessions. Noah demonstrated an increase in number of turns taken in the first session (n=5) in which the intervention was introduced. He also demonstrated treatment effect (i.e. an increase of at least two symbolic communicative turns more than the highest number of turns observed at baseline for two consecutive intervention sessions) after two intervention sessions. Noah demonstrated some variation in performance in the five intervention sessions (range = 1-7 turns) although all sessions were higher than baseline performance. Noah took 1 and 24 turns during his two intervention generalization sessions. Using Tau U, a strong intervention effect of .92 was calculated for Noah.

The results for Noah must be interpreted with some caution as there was a pause of 27 days between the collection of the last point in baseline for Noah, and the beginning of intervention. During this time, Noah was absent from the school program due to a family vacation and unfunded days at the ECE program. In a multiple-probe design, intervention should begin immediately after the collection of the last baseline data point (Horner & Baer, 1978). A decision was made to begin intervention without additional baseline data (i.e., in spite of the pause in data collection) because of Noah's frequent absences from the program, and a concern that data collection for intervention would not be completed by the end of the school program. It should also be noted that Noah had a score of zero for all 13 baseline probes over a 70 day period, providing strong evidence of low levels of social interaction (i.e., no turns) prior to intervention.

It is also important to note that Noah was the most limited in both his method and mode of communicative behavior. He was identified to be an emerging unconventional communicator, one level below both Bella and Matthew on the Communication Matrix (Rowland, 2003; Rowland, 2011) as indicated by the SLP who worked with the participants. Due to time limitations associated with the summer session of the early childhood special education program, as well as Noah's frequent absences, Noah participated in the fewest number of intervention sessions.

Social Validity

The four ECSE professionals (two teachers, an OT, and a para-educator) who provided information on social validity reported a positive view of the intervention (see Appendix C: Social Validity Responses). Three of the four professionals agreed (n=2) or strongly agreed (n=1) with the statement "The intervention could be implemented in the ECSE classroom or natural environment by a teacher/therapist" (one professional neither agreed/nor disagreed with this statement). All four agreed (n=1) or strongly agreed (n=3) with the statement "The activity would be beneficial for other children with autism". All four strongly agreed with the statement "The child enjoyed participating in the research study". Finally, two professionals agreed, and two professionals strongly agreed with the statement "The child's communication skills improved as a result of this intervention".

Chapter 4

Discussion

This study adds to the increasing evidence that a video VSD approach can support positive communication outcomes for individuals with ASD and complex communication needs who are beginning communicators (e.g. Babb, Gormley, McNaughton, & Light, 2018; Caron et al., 2018; O'Neill, Light, & McNaughton, 2017). Caron et al. (2019) provides evidence that older individuals with ASD can be supported in increased participation and communication in social interaction using a video VSD approach. The current study provides an investigation of video VSD technology with a new population, young children with ASD and complex communication needs, and provides similar positive results, with increases in the communication turns (Tau U of .92-1.00) seen for all three of the participants.

The positive results could be due to one or more of the following unique qualities of video VSD technology (Caron et al., 2018; Light, McNaughton, & Caron, 2019): (a) communication opportunities embedded directly within each video serving as an implicit prompt to communicate, (b) communication opportunities embedded directly within each video reducing attention shifting and minimizing interaction demands and the challenges of producing turns (i.e. communication), (c) easily recognized vocabulary for interesting items and activities available as hotspots, and/or (d) personally relevant vocabulary and motivating activities. Each of these may serve as a possible cause for the results seen here.

Implicit Prompts

In typical development, young children learn language concepts within the contexts of their daily interactions during meaningful and motivating activities. Young children with ASD, however, often fail to recognize social cues and miss opportunities to engage in social routines

(Mundy & Sigman, 2015). The appearance of a VSD within a video (as in a video VSD approach) provides an implicit prompt to communicate (Caron et al., 2019) "because the motion of the video is interrupted by the appearance of the VSD (i.e., a still image and a pause in the video"). In the current investigation, video VSDs were programmed to appear every 30 seconds, throughout the 5- minute video. Upon a VSD appearing within the video, the researcher stated "I see a _ (activated hotspot), what do you see?" while activating one hotspot on the screen of the tablet. The researcher looked at the child, and provided an expectant pause of at least 5 seconds to allow for an opportunity for the child to take a symbolic communicative turn. The appearance of VSDs with hotspots during a video VSD activity provides a clear cue to the child that there is an opportunity to communicate.

Reduction of Attention Shifting and Communication Demands

Traditionally, it has been difficult to support participation in social routines for beginning communicators with ASD due to the learning demands of AAC technology (Light, McNaughton & Caron, 2019; McCarthy et al., 2016). Young children with ASD are at risk for delayed development of joint attention, social, and communication skills, making it especially critical to identify AAC supports that do not impose additional attention demands (Light & Drager, 2007). The results of the current study, as well as the study by Caron et al. (2019), provide evidence that the integration of AAC supports within a preferred video (i.e., video VSD) is highly effective at supporting communication and social interaction for children with ASD and complex communication needs. Because the AAC supports are integrated seamlessly into the video, there is no need for the child to divide attention between the video, the AAC system, and their communication partner (Light, McNaughton & Caron, 2019). As a result, the child can use the communication supports while remaining engaged with the activity and the partner, and can also more easily attend to models of system use (e.g., activation of hotspots) provided by the partner. All participants immediately increased the number of communicative turns taken when provided with video VSD technology and all intervention probes (and all but one generalization probe) were above the highest point seen in baseline.

Contextual Support for Vocabulary

Young children often struggle to recognize the abstract symbols used to represent vocabulary in AAC systems (McCarthy et al., 2016; Worah et al., 2015). The contextual support provided by the surrounding video may have assisted the children in recognizing the hotspots which appeared in the videos (Light, McNaughton & Caron, 2019; Light, Wilkinson et al., 2019), thereby supporting their active participation.

Access to Personally Relevant Vocabulary

Often AAC interventions for beginning communicators focus primarily on teaching requests for objects or activities (e.g. snack items) to the neglect of social closeness and commenting/exchanging information (Ganz, 2015). Vocabulary which has been selected to support the communication of a small number of basic needs and wants will be of limited usefulness in supporting social interaction with children with ASD. In addition, many young children with ASD demonstrate limited speech development, and a strong preference for solitary activities, including personally preferred video/media content (Mazurek & Wenstrup, 2013; Shane & Albert, 2008). With these challenges, it can be difficult to create motivating opportunities for social interaction.

Video VSD technology serves as an effective context to support social interaction and communication for young children with ASD because of the use of high-interest videos for the child, as well as hotspots that are selected and programmed with vocabulary based on the unique interests of the child. In the current study, the videos selected were unique to each child based on the child's favorite videos, and the vocabulary reflected preferred characters, places, or objects within the video. Providing access to communication through motivating vocabulary programmed into hotspots encourages high levels of engagement for the child not only with watching the video, but also with the communication partner as the partner models the use of hotspot vocabulary within the video.

Generalization

Results for the generalization sessions provide evidence that the children used the video VSD technology to participate in social interactions with the generalization partner. Of particular interest is the fact that Noah took 24 turns (his highest number of turns for the entire study) in his last generalization session. Prior to this final session, his highest number of turns was seven. One possible explanation is that Noah was more interested in the video that was viewed with the generalization partner during this session; although this video was also used in baseline, it had not previously been used in an intervention session (i.e., used with hotspots made available). Another possible explanation is that unlike Bella and Matthew (who were described as "emerging conventional communicators" using the Communication Matrix), Noah was described as an "emerging unconventional communicator". He therefore may have required more opportunities to practice and use the video VSD technology before fully engaging in the interaction, and obtaining a high number of turns (i.e., closer in frequency to the other two children).

Social Validity

Social validity responses collected from four ECSE professionals provides evidence that their perception of the intervention was generally a positive one. The responses also indicated that classroom implementation of the video VSD interaction activity was of interest but would require additional staff training as to how to embed the use of the video VSD technology into the daily routines and activities of the ECSE classroom.

Limitations and Future Research Directions

There were a number of study limitations, including the small number of participants, as well as the limited number of intervention sessions (and lack of maintenance data for some participants) due to time constraints related to the summer session schedule. Although the overall results of this study provide evidence of the positive impact of video VSD technology as a communication support for children with ASD, due to challenges associated with intervention research in classroom settings (e.g., gaps in data collection because of participant attendance and program scheduling), the results should be interpreted with caution. For example, although Noah demonstrated a stable baseline, and took no turns during the collection of baseline data, confidence in the relationship between the intervention (i.e., the introduction of the video VSD) and his change in performance would have been increased if additional baseline data had been collected immediately prior to intervention.

In addition, although the behavior of the participants met the definition of "symbolic communicative turn" as traditionally defined in the literature (Binger & Light, 2007; Therrien & Light, 2018), it should be emphasized that these are beginning communicators, and by definition are at the beginning stages of learning to communicate a symbolic message to their communication partner. It is clear, however, that they were more frequently taking turns in an interaction using clearly recognizable communication signals - this increased use of symbolic communicative turns is an important first step to more sophisticated and interpretable communication behavior (e.g. Ganz & Hong, 2013; Ratcliff & Cress, 1999).

The data for this study are presented as turns per session (i.e., turns that took place during interactions around a 5-minute-long preferred video). The participants typically engaged in multiple turns per session once the video VSD app was introduced during intervention, therefore even though the length of the videos was held constant at 5-minutes, those sessions in which participants took turns are longer in duration during intervention. Although the use of turns per session is an accepted approach in the literature (Edmister & Wegner, 2015; Thiemann-Bourque, 2012), it is also of interest to report the change in rate of interaction (i.e., number of turns per minute).

Finally, it may also be important to explore the impact of embedding the video VSD technology within ECE program routines and activities, and including families (parents, siblings) to promote communication and social closeness during a highly preferred activity for the young child with ASD. Future research should investigate the use of a video VSD approach over an extended period of time with a larger number of participants, the use of a variety of methods to analyze the interaction, and the use of the video VSD intervention in naturalistic contexts with familiar communication partners.

Conclusion

The results of this study offer initial evidence that the introduction of video VSD technology can increase the number of symbolic communicative turns taken by young children with ASD and complex communication needs took during a high-interest shared activity (i.e., watching videos). AAC intervention must support interaction and communication during the preferred activities of the individual with complex communication needs. The use of video VSDs, which provide embedded communication supports during video viewing, is a promising approach to communication intervention for beginning communicators with ASD.

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Appendix A

Figures

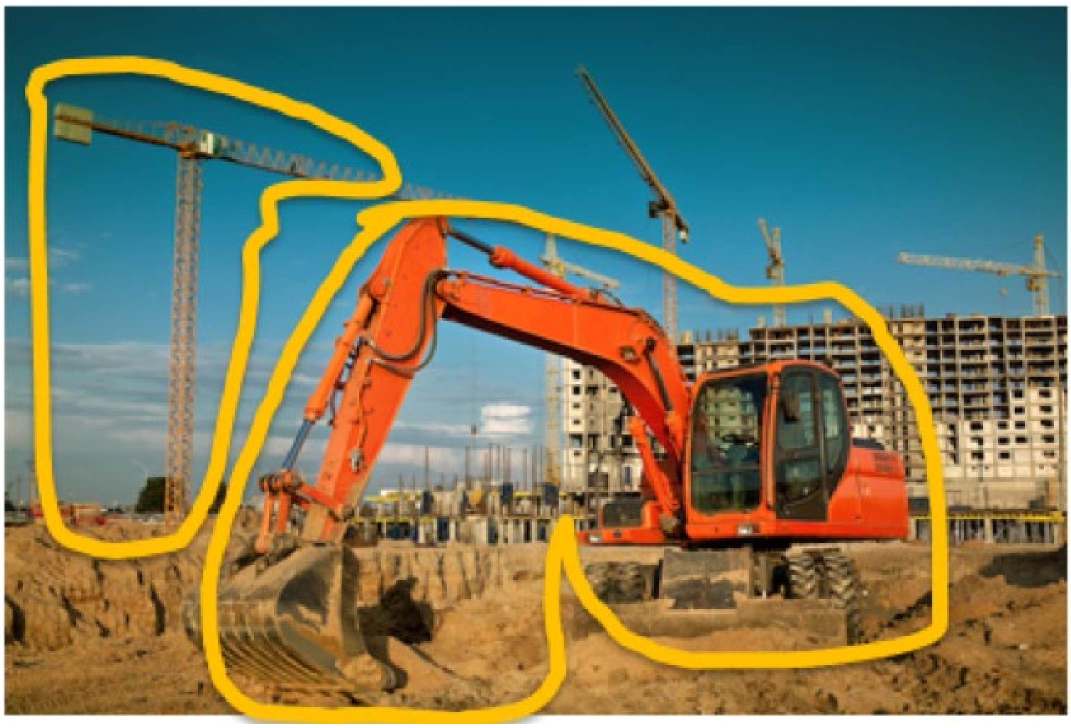

Figure 1. Example of VSD with hotspots for *Crane* and *Digger.*

The video in the VSD app shows a clip of the construction vehicles digging and moving at the construction site. When the clip pauses, the still image (VSD) with hotspots appears. After hotspot activation, (e.g. the child touches the image of the crane), and speech output (i.e., the spoken word *crane)*, the viewer can press play to continue the video or spend more time on the VSD to share messages.

Time	Vocabulary (programmed hotspots)
:30	crane, digger
1:00	bulldozer, crane
1:30	shovel, dirt, wheels
2:00	digger, hat, bucket
2:30	cement truck, bucket, water
3:00	bricks, shovel, digger
3:30	man, hat, boots, dirt
4:00	dump truck, man, dirt, shovel
4:30	wheels, lights, dump truck, digger
5:00	house, man, bulldozer, crane

Figure 2. Vocabulary (hotspots) for construction video VSD.

A total of 32 hotspots appeared in the 5-minute video, with 16 different vocabulary items (some items are used in more than one VSD).

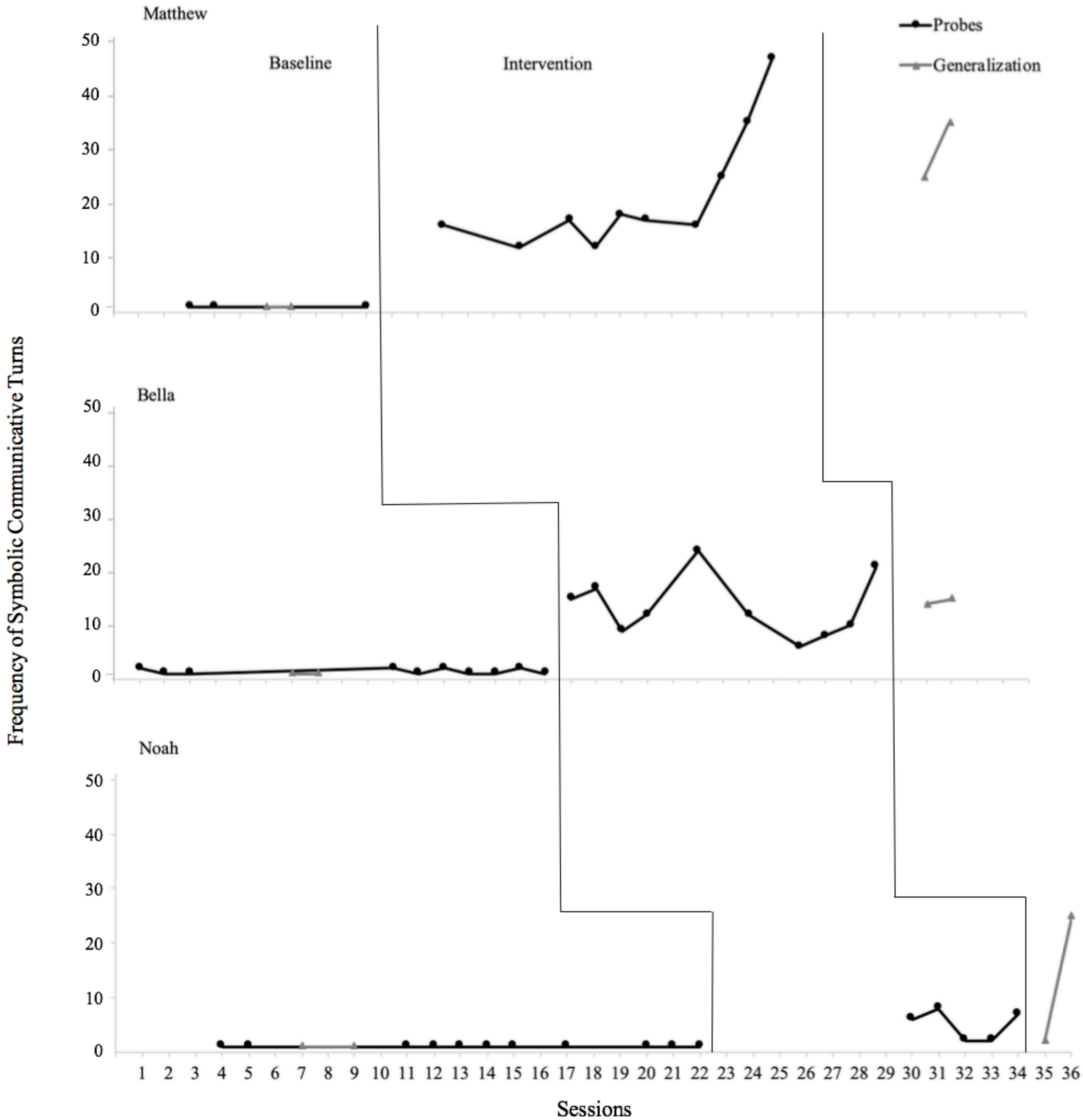

Figure 3. Number of Symbolic Communicative Turns Taken by Participants

Appendix B

Review of Relevant Literature

There are three areas of research relevant to the present study: the language and social development of young children with autism spectrum disorder (ASD); the participation of children with ASD in social and recreational activities; and the need for communication supports, including augmentative and alternative communication (AAC), for young children with autism spectrum disorder.

Language and Social Development for Young Children with ASD

ASD diagnosis. Difficulties in social communication, including deficits in social-emotional reciprocity; nonverbal communicative behaviors used for social interaction; developing, maintaining, and understanding relationships; and the demonstrated use of restricted and repetitive behaviors, are core characteristics of ASD (American Psychiatric Association, 2013). Approximately one in every 59 children has a diagnosis of ASD (Center for Disease Control, 2018) with a higher incidence found in boys (1:42) than girls (1:89), according to Baio et al., (2018). Individuals with a diagnosis of ASD have difficulties in most aspects of their lives (St. John et al., 2016) and experience lifelong barriers to full participation in social, play, and leisure activities and contexts (Tanner, Hand, O'Toole, & Lane, 2015).

Language development. Communication can be described as the exchange of shared meanings using spoken, signed, written, verbal, nonverbal, simple and complex symbols, and natural gestures (Kaiser, Hester, & McDuffie, 2001). Communication goals for a preschool-age child (3–5 years of age) include the ability to use appropriate and effective strategies to interact with same-age peers. Key communication behaviors at this stage of development include initiation of interactions, provision of appropriate responses to others, use of conflict resolution strategies, and sustained engagement in social play or group activities (Hunt, Doering, Maier, & Mintz,2009; Case-Smith, 2013; Guralnick, 2010).

In typically developing children, the acquisition of communication skills is usually smooth and seamless (Visvader, 2013) with young children learning language concepts while being exposed to a wide range of spoken language concepts during daily routines and activities (Light, 1997; Light, McNaughton, & Caron, 2019). For children with ASD and other developmental disabilities, new social and communication skills are often acquired slowly and intermittently. By age nine, 48% of children with ASD either have no or few spoken words, or speak using words but not sentences (Anderson et al., 2007). While some individuals with ASD do acquire speech skills at a much later age than their typically developing peers, approximately 30-40% of individuals with ASD may not ever develop or use spoken language (Ganz, 2015; Tager-Flusberg & Kasari, 2013).

Effective communication is imperative from an early age to ensure a child is able to express wants and needs, interact socially to develop friendships and social bonds, learn about the world, expand their cognitive skills, and develop the foundations for later language and literacy skills (Light, 1997). While most young children develop language and have access to the “magic and power of communication” (Light & Drager, 2007), almost half of all children with ASD have complex communication needs, meaning speech alone does not meet their daily communication needs (Anderson et al., 2007). In part because of these difficulties with speech, these children often have limited social interactions with others, and do not enjoy the benefits of communication with partners.

Social development. The social domain includes a wide range of abilities, including social attention, prosocial overtures, and friendship development. Social deficits are core features in the diagnosis of ASD (DSM-V, 2013). Because children learn language within a social context, social behavior is an important area to assess for children who are minimally verbal (Kasari, Brady, Lord, & Tager-Fusberg, 2013) as well as children with ASD who experience significant deficits and have no functional use of speech (Taylor, Maybery, Grayndler, & Whitehouse, 2014). It is important to note that for those children with ASD who develop speech, they tend to use it to satisfy their primary needs rather than as a social communicative tool (Smith, 1999; Holt & Yuill, 2014). As a result, they miss out on the rich social and language learning opportunities afforded by social interaction with peers and others.

For most children with ASD, learning to interact with peers while effectively communicating is not an intuitive process (Ganz, 2015). These challenges in social interactions are most likely due to communication deficits (Sartini, Knight, & Collins, 2013). The children with ASD often have limited interactions with others, and, in part because of these limited interactions, do not demonstrate (or are slow to acquire) important social and communication skills (turn-taking, appropriate initiations and responses to partners, etc.). For example, children with ASD rarely respond or initiate conversation as often as their peers (National Research Council, 2001) and are at a higher risk for social isolation (Benner, Rogers-Adkinson, Mooney, & Abbott, 2007; Sartini et al., 2013).

The ability to share events, emotions, and interactions with others, as well as represent shared meaning between partners around objects and events, begins with the ability to engage in joint attention with another (Freeman, Gulsrud, & Kasari, 2015). Due to deficits in socialization and joint attention, preschoolers with ASD have difficulty in taking turns during leisure activities with communication partners (i.e. peers or teachers) (Kaczmarek, 2002). Failure to take turns appropriately is strongly associated with low levels of social acceptance for young children in preschool (Kim & Clarke, 2015).

Freeman et al. (2015) reported on a longitudinal study that examined the influence of early joint attention and play in children with autism on friendship quality in later childhood. The results indicate that young children with higher levels of joint attention skills at age three were more likely to have friendships with higher closeness and lower conflict at a later age. Joint attention skills are also predictive of the development of later language skills (Gulsrud et al., 2014; Kasari, Gulsrud, Freeman, Paparella, & Hellemann, 2012).

Participation in Social and Recreational Activities

Participation in social and recreational activities, including interactive play with a partner during games and other social activities is an important developmental opportunity in childhood. Extensive research suggests that children learn best when they are active and engaged participants in a meaningful activity, and when an activity is socially interactive (Hirsh-Pasek, et al., 2015, Chi, 2009). For young children, interactive play with others is a major learning tool for communication (Barton & Wolery, 2010; Hart & Risley, 1975)

Children with ASD, however, are particularly at risk for limited activity participation, and several studies have shown that children with ASD participate in activities less frequently and with less variety than do children with other developmental disabilities (DD) and typical development (LeVesser & Berg, 2011; Rodger & Umaibalan, 2011). Children with ASD are more likely to spend time in passive play (demonstrating restrictive and repetitive behaviors with play objects) and exhibiting maladaptive behaviors that reduce the likelihood of peer interaction (Bauminger & Kasari, 2000). Children with ASD showed a remarkably low social but high solitary play activity during a typical day (Memari et al., 2015) and show deficits in both functional and symbolic play (Jarrold, 2003). Memari et al (2015) also reported that for children with ASD, communication deficits are associated with lower engagement in social play activities.

Individuals with ASD who struggle with communication, social skills, and emotional difficulties (Bohnert, Lieb, & Arola, 2019; Tuchman, 2003), experience decreased diversity of participation in recreational and leisure activities across the lifespan (Ratcliff, 2019). Social skills, including the ability to recognize the social cues of others (Ayvazoglu et al., 2015) and to use social skills to support or engage in reciprocal interaction with others (Tobin, Drager, & Richardson,2014), is an area of difficulty for children with ASD. These skills are critical to successful participation in leisure or recreation activities.

There is growing evidence, however, that children with ASD can be supported in learning to make use of more appropriate communication behaviors during social interaction and play with others (e.g. Charmon & Baron-Cohen, 1997; Thiemann-Bourque, Brady, & Fleming, 2012). A variety of methods have been used to teach social communication skills within play activities to children with ASD, including reciprocal play with a classroom peer (with or without typical development) and teaching independent pretend play skills. Methods include video modeling (e.g. Roberts, MacDonald, & Ahearn, 2007), shared reading experiences (e.g.Therrien & Light, 2018), and play scripts (e.g. Murdock, Ganz, and Crittendon, 2013).

Consideration of the child's preferences has been identified as a key component in successful play interventions (Dunst, Trivette, & Masiello, 2011). Chapin, McNaughton, Boyle and Babb (2018) conducted a systematic review on the effects of peer support behaviors on the communication of young children with ASD. They reported that those intervention studies that selected intervention (e.g. play) materials based on the interests of the child with ASD yielded a large overall level of effect (IRD=.72) on the communication behaviors of the child with ASD, compared to a moderate overall effect size (IRD=.56) yielded when materials were selected based on classroom routine and availability.

Use of videos & screen-based media. Individuals with ASD are noted to show high interest in computer programs and videos (Althaus, Sonneville, Minderaa, Hensen, & Til, 1996; Shane & Simmons, 2001). Parents of children with ASD have reported their children to be “mesmerized” by certain characters and experiences within favorite videos and also imitated those activities and behaviors depicted in the film (Shane & Simmons, 2001). Parents reported that on average, their child with ASD spent approximately 4.5 hours per day watching television and playing video games compared to 2.8 hours a day in non-screen activities (including reading, studying, spending time with friends, engaging in physical activity; Mazurek & Wenstrup, 2013).

Moore and Calvert (2000) reported that children with ASD were attentive in a teacher-only intervention condition for 62% of the duration of the intervention period, but were attentive 97% of the time when the intervention condition was computer-oriented. Mazurek and Wenstrup (2013) theorized that children with ASD may prefer video game play to more self-directed or generative play activities because video games provide inherent structure (game rules), prompting (predetermined options), and immediate reinforcement (clear visual/auditory cues and opportunities for mastery). Based on the evidence that children with ASD spend an extensive amount of time engaged in TV viewing and video games, they are at high risk for missing out on many language learning and social interaction opportunities that other children experience within their recreation and play activities.

Children with ASD also are noted to have an interest in stimuli that is dynamic in nature, like videos (Mazurek & Wenstrup, 2013; Geiger, LeBlanc, Dillon, & Bates, 2010; Mechling & Moser, 2010). Research has shown that video stimuli, specifically stimuli that is dynamic in nature (e.g. videos on YouTube, moving images on the screen), attracts the visual attention of individuals with ASD (Brodhead, Abston, Mates, & Abel, 2017; Jagaroo & Wilkinson, 2008). To date, however, there is only limited research regarding the use of video in supporting expressive communication for individuals with ASD (Brodhead et al., 2017). Caron, Laubscher, Light, and McNaughton (2019) reported on the positive impact of the use of video visual scene displays (Light, McNaughton, & Jakobs, 2014) with adolescents with autism. To date, however, the use of interactive video as a communication support for young children with ASD has not been investigated. The appeal of videos and interest in dynamic stimuli may serve as a potentially motivating and supportive intervention tool for young children with ASD when combined with play (Huist, McCarthy, Boster, & Benigno, 2018).

AAC Supports for Young Children with ASD

Teaching children with ASD to participate in meaningful leisure activities (i.e. social play or shared interests), while supporting communication and active engagement in early childhood routine and activities presents a particular challenge for early childhood educators (Gonzalez-Lopez & Kamps, 1997; Sartini et al., 2013).

AAC interventions and children with ASD. Preschool children with significant communication impairments associated with developmental disabilities frequently experience difficulties communicating with family members, teachers, and peers (Beukelman & Mirenda, 2013; Johnston, Reichle, Feeley, & Jones, 2012). AAC approaches to language intervention are a means to facilitate communication competence for individuals with developmental disabilities and complex communication needs (Beukelman & Mirenda, 2013; Johnston et al., 2012; Romski & Sevcik, 2005). The primary purpose of AAC is to increase opportunities for communication by providing an additional modality through which individuals can communicate with many different people in their lives (e.g., parents, siblings, peers, educators, etc.).

Multimodal augmentative and alternative communication (AAC) systems can be used to meet the diverse needs of young children with CCN and ASD, and can substantially improve communication (Cress & Marvin, 2003; Ogletree, Bruce, Finch, Fahey, & McLean, 2011; Reichle, 2010; Romski et al., 2010; van der Meer, Sutherland, O' Reilly, Lancioni, & Sigafoos, 2012). Support for the communication development of children with ASD should focus on the same communicative functions as spoken communication (Cress & Marvin, 2003). With the increasing prevalence of ASD and evidence suggesting the likelihood of a child with ASD to develop early deficits in language development, AAC should be considered a crucial component of early intervention for young children with ASD and CCN (Kasari et al., 2013).

Most research on ASD and AAC has focused on behavior regulation or the use of AAC to request wants and needs (Ganz et al., 2011; Ganz, 2015). There is a very large body of literature supporting aided AAC as a means of supporting individuals with ASD to make requests (e.g. Baxter, Enderby, Evans, & Judge, 2012; Cafiero & Delsack, 2007; Ganz, 2015; Kagohara et al., 2013). There is a clear lack of research addressing the use of AAC to support other communicative functions, such as social interactions to develop friendships and social bonds, learning about the world, expanding cognitive skills, and developing the foundations for later language and literacy skills (Ganz, 2015; Light & McNaughton, 2015).

Light, Collier, and Parnes (1985) reported that young children found it difficult to use their AAC systems when they were playing. Children were often required to "leave" their play when they used their AAC systems (Light et al., 1985). Brady et al. (2011) reported that children learning AAC communicated at relatively low rates in their classrooms, most often responding to adult initiations (i.e., initiation rate of .13 communication acts per minute and response rate of .49 communication acts per minute). For young children, it is recommended that teachers facilitate language development by providing augmented communication input as well as opportunities to communicate with AAC (Drager et al., 2006; Harris & Reichle, 2004; Jones & Bailey-Orr, 2012; Romski & Sevcik, 2005; Sevcik & Romski, 2002). Implementing these strategies within the classroom, however, may be difficult, due to competing demands on teachers' time. Furthermore, research on partner instruction in AAC has clearly shown that many communication partners (e.g., educators or paraeducators) lack the skills necessary to effectively support successful communicative interactions with those who use AAC (Douglas, Light, & McNaughton, 2013; Kent-Walsh & McNaughton, 2005).

Modes of communication. A wide variety of AAC interventions have been demonstrated to have a positive impact for children for young children with CCN (Light & Drager, 2007; Romski, Sevcik, Barton-Hulsey, & Whitmore, 2015). Successful AAC interventions have included unaided approaches such as sign language or other symbolic gesturing, and aided approaches such as Picture Exchange Communication System (Bondy & Frost, 1994, 2001; Frost & Bondy, 1994, 2002) and speech-generating devices (see reviews by O'Neill, Light & Pope, 2018; Preston & Carter, 2009; van der Meer & Rispoli, 2010).

Traditional AAC systems based on symbols and grid layouts can be challenging for very young children (e.g. Light & Drager, 2007; Drager, Light, Curran-Speltz, Fallon, & Jeffries, 2003; Light et al., 2004; Mirenda & Locke, 1989). There is reason to believe that traditional grid-display forms of AAC are not developmentally appropriate for young children with consideration to the level of cognitive demands a traditional grid-display may place on the child (Light & Drager, 2002).

Visual Scene Displays. Recently, the assumption that the traditional grid display is the most effective and efficient “fit” for all individuals with CCN has been challenged (Light et al., 2019). Visual scene displays (VSDs) are one type of AAC that has most recently been demonstrated to benefit young children with CCN, while supporting their communication and language development (Light et al., 2019; Light & McNaughton, 2015; Wilkinson & Light, 2014). In a VSD approach, “representations are embedded in a full or integrated scene” (Wilkinson, Light, & Drager, 2012, p.137). VSDs have been used to support the communication of young children with CCN and encourage self-expression by children with CCN through a visual modality that is closely representative to the basic principles of early language learning. Wilkinson and Light (2011) reported that typical early language develops through the use of an unknown word spoken by familiar caregiver, while an experience with the item representative of the novel word is provided in a contextual manner to the individual child’s life. The development of communication and learning language is noted to occur within a rich, context-based environment (Nelson, Heitman, & Jennings, 1986); the rationale for using VSDs with young children, therefore, is based on this same idea - embedding language concepts into events that are familiar in the form of photographs within the VSD (Drager, et al., 2003; Light, et al., 2004; Wilkinson & Light, 2011; Wilkinson, Light, & Drager, 2012).

VSDs incorporate photographs or line drawings of natural scenes within which communication concepts are embedded (Wilkinson & Mitchell, 2014). The images have hotspots that the learner taps or selects to produce voice or sounds. VSDs encourage language through use of familiar photographs or images, while providing contextual support for language learning. Results from a growing number of research studies supports the benefits of VSDs to support the communication needs of individuals who are learning language (e.g. children with ASD) and those who are limited in cognitive and/or language development (Light & McNaughton, 2013; Light et al., 2019).

Video VSDs. Video VSDs are another type of aided AAC display, in which hotspots are embedded within a "still" image (i.e., a VSD) generated from video clips. To create a video VSD, the adult communication partner obtains a video (which can be made with the tablet camera or imported from an online source). The adult communication partner pauses the video at salient points, and creates still images (screen shots) of particular points in the video. The adult communication partner then creates hot spots in those still images. As seen by the user, the video plays until a VSD is reached in the video – the video then pauses and the user has a choice of hotspots. Speech output occurs when the hotspot is activated. As represented in the EasyVSD app, the user can also see the available VSDs as a series of stills in a column next to the window in which the video plays (see Appendix B for example).

Potential benefits of a video VSD approach. The use of preferred videos offers promising opportunity for creating interaction. Familiar images and videos can be used, based on the interests of the child, while providing opportunities for shared communication between the child with CCN and the communication partner. Reduction of attentional demands by integrating AAC systems within the play activity (Cress, 1999; Light & Drager, 2002), or in this sense, the preferred video, is another highly important benefit to considering the use of video VSDs to support communication and social interaction among young children with CCN. A video VSD approach incorporates suggestions made by Light and Drager (2002) in their discussion of infusing AAC into play and recreation experiences of children with CCN.

Video VSDs provide implicit prompts for participation, reduce attention shifting and communication demands, simplify the process of learning vocabulary representations, and provide a preferred context (and vocabulary) as hotspots in familiar visual scenes in an interest based activity (Caron et al., 2019; Light et al., 2019). Recently, Caron et al. (2019) investigated the use of video VSDs in preferred YouTube videos with adolescents with ASD, and observed an increase in initiations and communicative turns by the participants while watching the video with the researcher. This study of the integration of communication into a preferred recreation activity (watching YouTube videos) provides initial evidence that video VSD technology can serve as an important communication support for individuals with ASD who are symbolic (i.e., recognize images as representations of real world objects and activities), and that interaction could be introduced into what is often an isolated recreation activity (i.e., watching videos independently).

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Appendix C

Social Validity Responses

QUESTIONS: (1= strongly disagree; 5=strongly agree)	Class A: Teacher	Class B: Teacher	Class B: Para	Class A: OT
The intervention could be implemented in the ECSE classroom or natural environment by a teacher/therapist.	4	3	5	4
The activity would be beneficial for other children with autism.	4	5	5	5
The child enjoyed participating in the research study.	5	5	5	5
The child's communication skills improved as a result of this intervention.	5	4	5	4

What (if anything) was a major benefit of this intervention?

- *"The kiddos really enjoyed watching the videos and interacting with you. It was great that they were able to participate"(*Class A: Teacher)

- *"I think that with training I could do this in circle time. I could try to get the videos to match the monthly theme. We already use an iPad and pass it around, so we could use this program and see if all of my kids would be able to participate more in circle. It would be great to show the parents."(* Class B: Teacher)

- *"It was awesome that Bella and Noah both used the tablet to express themselves. Bella also used a lot of speech in the video that I saw and I loved seeing that! Noah is still working on connecting with others but his participation and interaction with you was a huge step!" (*Class A: OT)

- *"You always played with all of our kids even the ones you didn't work with. Our kids really liked all of the time with you. In the video, I think the thing that sticks out is that the kids were doing what you asked them to do and that you were giving them time." (*Class B: Para)

What (if anything) was a major challenge of this intervention?

- *"I felt so bad when you would drive to our center but your kiddos were absent. That's the only thing that I can think of."(* Class A: Teacher)

- *"When it was over. I think all of us, children included, kept looking for you. Also, you said the app was only being tested so it would be nice to be able to buy/use it."* (Class B: Teacher)

- *"You were awesome but we don't always have a Shelley. I think a challenge might be how to do this in our classroom?" (*Class A: OT)

- *"Nothing." (*Class B: Para)

Do you think you could use this intervention in your classroom?

- *"I think I could try. I don't know if this would be too tempting for all of the kiddos in the classroom and cause behaviors. I don't think we could go to a separate room each time but maybe for pull-out therapy sessions." (*Class A: Teacher)

- *"Yes, like I said, I could use this in circle time and maybe during our 1:1 sessions working on IEP goals."* (Class B: Teacher)

- *"Absolutely." (*Class A: OT)

- *"I could use this to fill in time with kids. Somedays I just don't know what to do and try to get the kids involved." (*Class B: Para)

Appendix D

Procedural Integrity Materials

YouTube Younger: Procedural Integrity Video:
Participant Code: Coder:____
Mark: + =if behavior occurred; **-** = if behavior did not occur____________________

Behavior of Researcher or Child		**1**	**2**	**3**	**4**	**5**	**6**	**7**	8	**9**	**10**
1. **Researcher** sits on floor across from child, within arm's reach of child											
2. **Researcher** holds tablet within 6 inches to face (below or beside)											
3. **Researcher** says to child "Let's watch a movie and talk about it together"											
4. **Researcher** presses play on video on tablet											
5. Upon 30 second prompt, **researcher** says "I see a ***, what do you see"											
6. **Researcher** points to tablet or activates hotspot in reference to comment in step 5.											
7. When video ends, **researcher** comments on the movie being over.											

Behavior of Researcher or Child: Mark: + if behavior is present; - if behavior is not present																																		
1. Child takes a communicative turn																																		
2. Researcher responds to child using expansion.																																		
1. Child takes a communicative turn																																		
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2. Researcher responds to child using expansion.																																		

Appendix E

Inter-Observer Agreement Materials

YouTube Younger Reliability: Please describe all responses made by the child. Refer to the Symbolic Communicative Turns definition for inclusion or exclusion.

Participant Code: Coder:______________________________________ Video:___

VSD #	HOTSPOT ACTIVATION-CHILD	SPEECH/SPEECH APPROXIMATIONS-CHILD	NOTES: IF TURNS ARE TAKEN BUT NOT COUNTED AS PER RULES…	TOTAL COMM. TURNS BY CHILD PER VSD
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Appendix F

Symbolic Communicative Turn Definition

A **symbolic communicative turn** is defined as:

- (a) the use of recognizable speech (either speech approximations or through speech output from AAC app), conventional signs, or conventional gestures by the participant
  - to be coded as recognizable, it must be recognized by 2 raters after the event (when viewing the videotape) and
- (b) the participant uses eye contact or body orientation directed towards the communication partner. In the absence of eye contact, if a child either turns toward the researcher or communication partner or maintains existing orientation directed towards their partner (Therrien & Light, 2018).

Rules:

- Child activates hotspot:
  - If the child activates the hotspot multiple times without a 2 second pause or communication partner turn, this is still counted as 1 turn.

- Child uses speech:
  - If the child continues to express him/herself without a 2 second pause or communication partner turn, this is counted as 1 turn.

- A turn is considered to be over if the child does not make a communicative act (speech/speech approximations, AAC, sign/sign approximations, gesture) for 5 or more seconds.

- Child activates hotspot while looking up at ceiling, (i.e. with head tilted back), or with head/neck/body positioned under tablet:
  - The hotspot activation is NOT counted as a child turn

- Child and researcher are touching hands and child activates a hotspot:
  - The hotspot activation is NOT counted as a child turn.

- The researcher models activating the hotspot or points after commenting to facilitate a child turn immediately before child activates a hotspot:
  - The hotspot activation is NOT counted as a child turn.

Appendix G

Parent Survey about Child Interests & Media Use

Participant History & Demographic Information
To be completed by parents or teachers

Video VSD Project

Participant Information		
Name:		
Date of birth:	Current Age:	Gender: Male
Ethnicity (Please circle):	Hispanic or Latino	Not
Race (Please circle): American Indian or Alaska Native	Asian	
Native Hawaiian or Other Pacific Island	White	

Health Information	
Diagnosis:	
Date of Diagnosis:	

Recreation/Leisure Activities		
What does your child enjoy doing at home? The following lists some examples. Please describe if your		
Looks at books or pictures?	With Someone	Independently
List favorite books or pictures:		
How much time does your child spend looking at books or pictures?	Hrs/day	
Watches television?	With Someone	Independently
List favorite shows or characters:		
How much time does your child spend watching television?	Hrs/day	
Watches YouTube/online videos?	With Someone	Independently
List favorite videos/characters/topics:		

How much time does your child spend watching online videos?	Hrs/day	
Play games on tablet/computer?	With Someone	Independently
List favorite games:		
How much time does your child spend playing games?	Hrs/day	

Does your child participate in any other favorite activity or play with toys? Please describe below:

Communication & Language
Please describe how your child typically expresses her or himself- the following lists some methods. Include any/all that he or she may incorporate.
Speech, speech- approximations, vocalizations:
Sign-language, gestures:
Uses actual objects as references:
Refers to photographs or picture symbols:
Refers to communication boards or books:
Uses a device with a set number of messages:
Uses a computer technology (also called a Speech Generating Device or SGD):

Uses a mobile device (such as iPod Touch or iPad), with the app or apps:
How many words does your child express? (Estimate, if possible):
Does your child make 3-4 word sentences? If so, give an example:

Motor
In terms of motor tasks involved with technology, please describe his/her skills and needs related to:
Holding a Tablet device:
Directly pointing with finger:
Activating touch screen technology:
Swiping touch screen technology:

Sensory
VISION:
My child can see clearly enough to recognize photographs:
Other (please explain):
HEARING:
My child can hear clearly enough at conversation levels:
Other (please explain):

Behavior
Is your child involved in any behavioral program/intervention? Is so, please describe:

Please list any other information you would like to share.

Your Name	Relationship to Participant	Today's Date

VITA

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Ph.D in Special Education, The Pennsylvania State University	2019
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2017-Present	Educational Consultant, Early Intervention Technical Assistance (EITA), Harrisburg, PA
2017-Present	Pennsylvania's Learn the Signs. Act Early Ambassador, Centers for Disease Control and Prevention, Atlanta, GA
2017	Supervisor of Special Education, The Pennsylvania State University, University Park, PA
2016	Course Instructor of Special Education, The Pennsylvania State University, University Park, PA
2011-2016	Graduate Research and Teaching Assistant, The Pennsylvania State University, University Park, PA
2007-2008	Autism VB Teacher, River's Bend Academy, Suffolk, VA
2005-2008	Autism VB Therapist, Step-By-Step Consulting, Suffolk, VA
2005-2007	Severe Disabilities Teacher, Southeastern Cooperative Education Program (SECEP), Virginia Beach, VA

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