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Research Article

Effect of Video Augmentative and Alternative Communication Technology on Communication During Play With Peers for Children With Autism Spectrum Disorder

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ABSTRACT

Purpose: Children with autism spectrum disorder (ASD) are at risk for exclusion from play with their peers due to difficulty with communication skills. Video augmentative and alternative communication (AAC) technology has the potential to support communication within the context of play using videos with integrated visual scene displays. This study investigated the effect of a video AAC intervention on the number of turns in which children with ASD demonstrated symbolic communication during interactions with a peer without disabilities. Maintenance of skills, generalization to untrained play scenarios, and stakeholder perceptions of the video AAC technology were also investigated.
Method: This study used a single-case, multiple-probe design across participant dyads. It included baseline, intervention, maintenance, and generalization phases. Six children with ASD and six peers participated in the study.
Results and Conclusions: All six participants with ASD demonstrated an increase in the number of turns in which they demonstrated at least one symbolic communication act following intervention, although one participant demonstrated variability in baseline performance, making it difficult to draw conclusions. Results provide preliminary evidence that instruction with video AAC technology can support communication for children with ASD during play interactions with peers.

Difficulty with social communication skills is one of the core diagnostic features of autism spectrum disorder (ASD; American Psychiatric Association, 2013). During childhood, pretend play with peers provides an important opportunity to develop these social communication skills. For instance, play interactions are important contexts for learning the rules of conversation and for developing social skills such as sharing, turn-taking, cooperation, helping, and conflict resolution (Charlop et al., 2018; Schuler & Wolfberg, 2000). Pretend play may also help foster symbolic thinking (Schuler & Wolfberg, 2000). Moreover, play is a crucial context for friendship formation during childhood, with friendships frequently developing around shared play interests (Chang et al., 2016).

For children with ASD, play interactions with all peer partners can be valuable; however, interactions with peers with typical development have unique benefits, in that they (a) support a culture of inclusion and (b) provide a chance for the child with ASD to learn from a play partner who can model more advanced skills (Lory et al., 2018; Wolfberg et al., 2015). Peers can also benefit from these interactions, as they have a chance to learn to adapt their interaction to partners with different skills and abilities (Wolfberg et al., 2015). As schools increasingly adopt models of inclusive education, opportunities for play interactions between children with ASD and peers with typical development are also increasing (Lory et al., 2018).

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For children with ASD to participate in play activities with peers, they must develop communication skills to support interaction (Boudreau & Harvey, 2013). For example, they must be able to initiate communication and respond to their communication partner. Children with ASD may have difficulty with these skills; they are less likely than their peers to initiate and sustain social interactions, and they may not know how to approach their peers or what to say when they do (Charlop et al., 2018). Additionally, many children with ASD have limited speech; they do not rely on speech to meet all of their communication needs (Tager-Flusberg & Kasari, 2013). Difficulties with social communication, particularly when compounded by limited speech, may make it challenging for children with ASD to fully participate in play interactions with peers. As such, these children are at risk of being excluded from play interactions that serve as important opportunities for friendship formation, connection with peers, and practice of social communication skills.

Augmentative and Alternative Communication to Support Communication During Play

Many individuals with ASD can benefit from the use of augmentative and alternative communication (AAC) to support communication (Ganz, 2015). AAC aims to support and enhance an individual's communication through either unaided approaches (e.g., manual signs, gestures) or aided approaches (e.g., mobile technologies with AAC apps; Schlosser & Koul, 2015). AAC has been shown to enhance communication skills for children with ASD in a variety of contexts and with a range of communication partners, including during social interactions with peers with typical development (e.g., Ganz, 2015; Therrien & Light, 2018). For instance, studies have found increases in communication variables such as the frequency of communicative turns and the duration of social interactions for children with ASD following interventions involving the use of AAC to support interactions with peers (e.g., Garrison-Harrell et al., 1997; Therrien & Light, 2018). Several studies have introduced AAC to support communication for children with ASD within the context of play interactions with peers; however, these studies often place the peer in a mediator role rather than providing support for both children to interact as equals, and they typically use traditional AAC systems that may be difficult for young children to use (Light et al., 2019; Trembath et al., 2009; Trottier et al., 2011). There remains a need for research to develop interventions that integrate AAC to support children with ASD and limited speech to easily communicate, interact, and learn during play activities with their peers with typical development.

Video AAC Technology

Recent innovations in AAC technology have led to the development of mobile technology apps with video visual scene displays (video VSDs; Light et al., 2014) that may be particularly well suited to supporting communication for children with ASD during peer play interactions. Video VSDs include two primary components. The first component is a video that depicts a meaningful event or action such as a play activity. The video provides context for the conversation and may also support children with ASD to engage in play by providing a video model to clearly demonstrate potential play actions (Fragale, 2014). In fact, video modeling (in which an individual views a video demonstrating a target skill and then imitates the video) has been previously used successfully to teach children with ASD to perform functional and symbolic play actions, both during solitary play (e.g., Scheflen et al., 2012) and during play with peers (e.g., MacDonald et al., 2009). However, these studies did not explicitly provide AAC to support expressive communication in addition to play for participants with limited speech.

The second component of a video VSD is a visual scene display (VSD) to support expressive communication. As described by Light et al. (2019), VSDs are photographs of familiar events from a child's life. They include "hot spots" that, when touched, produce a word or message related to the scene. VSDs are particularly appropriate AAC supports for young children and beginning communicators, since they capture the contexts in which language is learned and used and embed vocabulary into these contexts. Research has shown that young children are able to use VSDs successfully to support communication with minimal instruction (Light et al., 2019). Using a video VSD approach, VSDs with hot spots are embedded within videos and appear automatically as the video plays, providing an opportunity to communicate.

Within the context of peer interactions, video VSDs have the potential to support both children within the dyad equally, providing each one with something to do (via the video model) and something to say (via the hot spots). This may benefit not only the child with ASD, who might require particular support in these areas, but also the peer with typical development, who may not be sure how to interact with their play partner with ASD (Light et al., 2019; Therrien & Light, 2018). Moreover, by integrating play and communication supports within a single platform, video VSDs help reduce demands on joint attention that would be significant if using multiple devices or apps (one to present a video model of the play activity and one to support expressive communication; Light et al., 2019).

Recent studies have shown that video VSDs are effective in supporting expressive communication for older individuals with ASD and limited speech across a range of vocational, volunteer, and community activities (e.g., Babb et al., 2019). Additionally, a number of studies have found gains in communication for individuals with ASD using video VSD technology during social activities with adults (Caron et al., 2018, 2019; Chapin et al., 2021) and peers (Babb, McNaughton, et al., 2021), but these studies did not target communication within the context of play. In a small pilot study, Laubscher et al. (2019) found that a child with ASD demonstrated an increase in frequency of communication turns with a peer across three different play activities following introduction of a video VSD intervention; however, this pilot study was preliminary in nature, involving only one participant dyad. Further research is required to better understand the potential effect of intervention involving video VSDs on communication for children with ASD within the context of play with peers.

Research Questions

This study investigated the following specific research questions.

1. What is the effect of intervention consisting of video VSD technology and instruction on the number of turns in which children with ASD demonstrate symbolic communication directed toward their peers?
2. Do the children with ASD generalize the use of video VSD technology to a new set of toys? Do they maintain their performance over time?
3. How do stakeholders (teachers) perceive the video VSD technology intervention?

Method

This study was approved by the institutional review board of The Pennsylvania State University. Parents of all participants provided written, voluntary, informed consent prior to the start of the study. Due to the young age of the participants with ASD and peers, the children in this study did not participate in a formal assent process; instead, if participants appeared happy and willing to engage, this was considered implied assent. Each participant has been given a pseudonym to protect their privacy.

Research Design

This study used a single-case, multiple-probe design across participant dyads (Gast & Ledford, 2014), with each dyad including one child with ASD and one peer with typical development. Two cohorts, each containing three dyads, participated in the study. The dyads included in each cohort and the order in which they entered the study were decided based on the schedule and availability of the children. A minimum of five probes were conducted per dyad during the baseline phase to establish typical performance (Kratochwill et al., 2013). When three consecutive data points showed a stable or decreasing baseline for Dyad A, intervention was initiated for that dyad, whereas Dyads B and C remained in baseline. When Dyad A demonstrated an intervention effect (i.e., when visual inspection revealed an increase in performance above the highest baseline data point across at least two consecutive probe sessions), Dyad B entered the intervention phase, whereas Dyad C remained in baseline. When Dyad B demonstrated an intervention effect, Dyad C entered the intervention phase. This pattern was then repeated for Cohort 2, with one exception: Intervention was initiated for Dyad E before a stable or decreasing baseline across three probes was achieved in order to be able to complete the study before the end of the school year.

Participants and Setting

Recruitment and Inclusion Criteria

Participants were recruited from two elementary schools in Pennsylvania. Classroom teachers who worked directly with students with ASD or typical development were asked to provide information about the study to families they believed would be interested. After reviewing information about the study and expressing questions or concerns, the parents of six children with ASD and six children with typical development provided consent for their children to participate.

Children were eligible to participate in this study if they (a) were between the ages of 4 and 9 years, (b) came from a family who spoke English within the home, (c) demonstrated motor skills that were adequate for playing with common toys and operating a touch screen tablet, and (d) possessed vision and hearing abilities (corrected or uncorrected) that were adequate for interacting with peers at a conversational level and viewing a 9.8- × 6.8-in. tablet. In addition to meeting the above criteria, participants with ASD (a) had a diagnosis of ASD, (b) demonstrated symbolic communication skills, (c) had speech that was inadequate to meet their communication needs during play interactions (i.e., participants were described by their teachers as having difficulty participating in daily interactions or peer play interactions when relying on speech alone), (d) were able to play safely with peers, and (e) were able to use familiar objects functionally. Participants with typical development (a) had no identified disability and (b) were close in age (within 2 years) of their peer partner with ASD. Teacher report was used to verify age; household language; motor, vision, and hearing status; ability to interact safely with peers; disability status of peers; and functional use of objects. Classroom observation of peer interactions and functional use of objects supplemented teacher report. ASD diagnosis was determined based on teacher report, as this research team did not have access to participant educational records. In addition to teacher report, the Childhood Autism Rating Scale (CARS; Schopler et al., 1988) was administered by the first author, who was previously trained in the use of this protocol, to determine ASD severity. To determine the language abilities of participants with ASD, teachers (a) verified that each participant demonstrated some use of symbolic communication and (b) completed the vocabulary checklist portion of the MacArthur–Bates Communicative Development Inventories (MCDI; Fenson et al., 2007) Words and Sentences form. Additionally, the first author or a trained research assistant (a licensed speech-language pathologist) administered the Peabody Picture Vocabulary Test–Fourth Edition (PPVT-4; Dunn & Dunn, 2004) to each participant with ASD to assess receptive vocabulary.

Participants With ASD

Six children with ASD, three girls and three boys, participated in this study (see Table 1). The mean age of these participants at the start of the study was 6;8 (years; months; range: 6;0–9;2). Two participants received CARS scores placing them in the mild-to-moderate range for ASD severity, and four participants received scores placing them in the severe range. All six demonstrated impairments in receptive vocabulary, receiving PPVT-4 scores that placed them below the 20th percentile. All participants with ASD were described by their teachers as having speech that was inadequate to meet their communication needs. Brian and Caleb both produced predominantly single words and word approximations and were reported to do so infrequently or primarily when prompted. Daniel and Felicity were also reported to produce primarily single words as well as occasional short phrases. Both were reported to use speech infrequently, particularly in social contexts, and to rely heavily on scripted speech. Ava and Emma were both reported to use phrases and sentences on a regular basis. However, use of speech was reported to be substantially reduced within social contexts, including play. Caleb was the only participant reported to use AAC to support expression. He used a communication notebook containing photographs of items and activities, which he used primarily for the purpose of requesting. On the MCDI, three participants (Brian, Caleb, and Daniel) received scores placing them in the "first words" stage of development according to benchmarks laid out by Tager-Flusberg et al. (2009), one participant (Felicity) received a score placing her in the "word combinations" stage, and two participants (Ava and Emma) received scores that exceeded the benchmarks for beginning communicators.

Peer Participants

Peer participants included five girls and one boy, with a mean age of 6;4 (range: 5;5–7;0). Five of the peers (Audrey, Brianna, Daisy, Evie, and Farrah) were classmates of the child with ASD with whom they were paired and were nominated because of shared interests and/or existing positive rapport with their classmate with ASD. One peer (Connor) attended the same school as his dyad partner (Caleb), but the two were not classmates. Connor was nominated as a peer for Caleb due to similar interests.

Setting

The study took place in two elementary schools in Pennsylvania. Sessions were conducted in quiet, private spaces. Participants sat next to each other at a child-sized table with the researcher or trained research assistant seated behind them in order to manage the toys and/or provide instruction, depending on the phase of the study.

Materials

Toys

Prior to the start of the study, the researcher chose a selection of toys that fit the following criteria: (a) They were developmentally appropriate for beginning communicators,

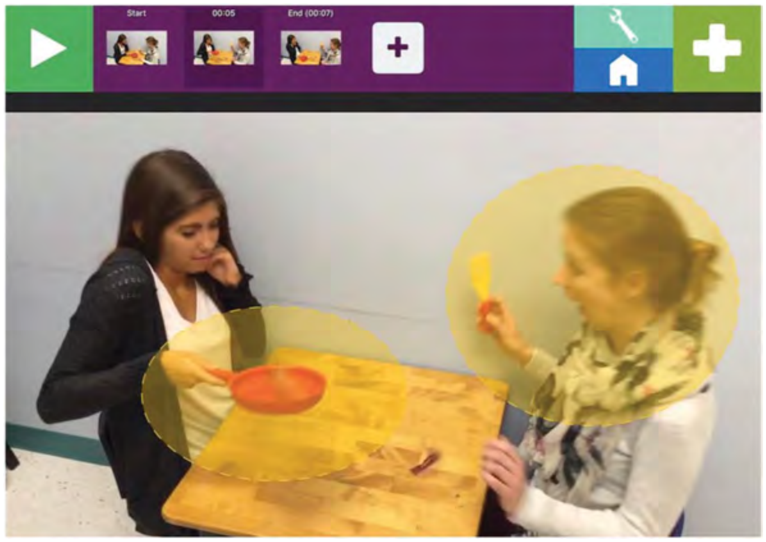
Table 1. Participant characteristics.

Name	Age and gender	CARS/severity	PPVT-4 (Form A)[a]	MCDI Words and Sentences[b]	Peer, age, and gender
Ava	6;0/F	31/mild-to-mod	81/10.0	680	Audrey/6;0/F
Brian	6;6/M	48.5/severe	68/2.0	233	Brianna/7;0/F
Caleb	9;2/M	39/severe	20/< 0.1	61	Connor/7;0/M
Daniel	6;8/M	39.5/severe	79/8.0	304	Daisy/7;0/F
Emma	6;4/F	36.5/mild-to-mod	87/19.0	680	Evie/5;5/F
Felicity	6;1/F	45.5/severe	65/1.0	469	Farrah/6;1/F

Note. Ages are in years;months. MCDI scores are based on the vocabulary checklist portion of the inventory. CARS = Childhood Autism Rating Scale; PPVT-4 = Peabody Picture Vocabulary Test–Fourth Edition; MCDI = MacArthur–Bates Communicative Development Inventories; F = female; mod = moderate; M = male.

[a]Standard score/percentile. [b]Number of words produced out of a total of 680.

Figure 1. Example of a video visual scene display (VSD) created using the GoVisual[1] application on an Apple iPad[2] used with the food toy set. In this example, participants push the green button at the top left of the tablet's screen to watch a video of models stirring and flipping bacon. At the end of the video, a VSD with hot spots programmed to produce the words "flip" and "uh oh" when touched (shown here as yellow shaded regions) automatically appears.



(b) they afforded opportunities for functional and/or pretend play, and (c) they could be used safely by children at all developmental levels (see the Appendix for descriptions of the chosen toys). Teachers and/or parents of each participant were then asked to identify which of the toy sets were most likely to be engaging, and toys were assigned to each dyad after considering the preferences of both participants within that dyad. Each dyad used one set of toys during the baseline, intervention, and maintenance phases and a second set of toys during the generalization phase. During baseline, intervention, and maintenance, Dyads A, E, and F used toy pets; Dyads C and D used play food; and Dyad B used toy cars. During generalization, Dyads A, B, E, and F used play food, and Dyads C and D used cars.

Printed Photographs

During the baseline phase, participants used printed photographs to select specific play actions related to their toy set (e.g., flipping bacon). Photographs of play actions were created by capturing a screenshot of the first frame from the video VSD for that action. Screenshots were printed (2.25 × 4 in.) and laminated. Five photographs were created for each toy set, representing five different play activities with the toys.

[1]GoVisual™ is available from Attainment Company, 504 Commerce Parkway, Verona, WI 53593, USA. http://www.attainmentcompany.com/govisual.

[2]The iPad is available from Apple Inc., 1 Apple Park Way, Cupertino, CA 95014, USA. http://www.apple.com/ipad/.

Video VSDs

Video VSDs were created and presented within the GoVisual (Attainment Company; http://www.attainmentcompany.com/govisual) app on an Apple iPad Air (Apple Inc.; http://www.apple.com/ipad/). For each toy set, five video VSDs were created. Each video VSD consisted of one video (in which research assistants modeled a play action) and one VSD with two hot spots to support communication (for a total of five play actions and 10 related hot spots per toy). Consistent with recommendations for supporting friendship between children with typical development and children with ASD, each play action was designed to include an important role for both participants (Finke, 2016). Play actions were also designed to include no more than two simple steps in sequence (e.g., "pour a drink, then spill it"). Each play action was video-recorded using an iPad and edited to eliminate extraneous activity if necessary. Videos were each less than 1 min in length. The completed videos were imported directly into GoVisual, where hot spots were then added to support communication. Hot spots were programmed to produce a single word, sound effect, or short phrase that was related to the action and appropriate for beginning communicators (i.e., concepts fell within one of the categories on the MCDI Words and Gestures form or were likely to be salient within the play context; Fenson et al., 2007). Out of the 10 hot spots per toy, three to five were nouns; three to five were action words; and three to five were sound effects, comments, or social words. Figure 1 provides an example of a video VSD, and the Appendix summarizes the toys, play actions, and hot spots provided for each set of toys used in the study.

Procedure

All sessions were conducted by the first author, a doctoral student in communication sciences and disorders, or a trained research assistant, a speech-language pathologist with extensive experience working with children with ASD. The first author conducted sessions for Dyads B, C, E, and F. The first author also conducted the initial sessions for Dyads A and D, after which the research assistant took over and completed the probes and intervention for these dyads. This allowed the researchers to better accommodate the schedules of the participants with ASD and the peers during the school day. Each dyad was seen 1–3 times per week, as scheduling permitted. The study consisted of four phases: baseline, intervention, generalization, and maintenance.

Probe Procedure

Each visit in the baseline, intervention, generalization, and maintenance phases began with a probe in order to measure the communication skills of the participant with ASD.

Baseline probes. Probes lasted approximately 10 min each. Participants were seated next to each other at a table, with the researcher positioned behind them. Five printed photographs, each depicting a play action (see the description above), were placed on the table in front of the participants. Participants were told that they would be taking turns choosing play actions and then playing together. The researcher assigned the first turn to the peer (e.g., "First, it's Audrey's turn to choose") and, if necessary, provided least-to-most prompting (pause, gesture, model) to help the peer choose a photograph depicting a play activity (e.g., "stir and flip the bacon"). After a selection was made, the researcher placed the toys corresponding to that activity on the table within reach of both children and then waited for 10–15 s to allow the children a chance to play together. The researcher did not interact with the children or prompt them in any way during this time. After 10–15 s, the researcher ended the turn by removing the toys and assigned the next turn to the participant with ASD. This pattern was then repeated for a total of 20 turns (10 for the peer and 10 for the participant with ASD). Nonspecific feedback was provided at least once per probe (e.g., "Great job playing together").

Intervention probes. During the intervention phase, all probe procedures were identical to baseline, except that the iPad with video VSDs was provided instead of the printed photographs. The participants viewed a home screen that contained five thumbnails, each corresponding to the first frame of a video VSD. These thumbnails were identical to the printed photographs used for selecting play activities in baseline. When a thumbnail was selected, the corresponding video played, demonstrating a specific play action, and then paused, revealing a VSD with hot spots related to that action. Once the video paused, the researcher provided the appropriate toys and waited for 10–15 s while the participants had a chance to play together. Video VSDs remained available during the 10- to 15-s interval, and participants were free to interact with them by selecting hot spots or replaying the video as they wished.

Generalization probes. Each dyad also completed one generalization probe during the baseline phase and two generalization probes during the intervention phase with the exception of Dyad F, which was only able to complete one generalization probe during the intervention phase before the school year ended. Generalization probes during baseline and intervention phases followed the same procedures as the baseline and intervention probes, respectively. During generalization probes, each dyad used a new set of toys that included no props, actions, or hot spots that overlapped with their primary toy set. Participants had never viewed the photographs or video VSDs for their generalization toys prior to the generalization probes.

Maintenance probes. Dyads A, B, and D each completed one maintenance probe, conducted 1 week after the last intervention probe. In the case of Dyad C, a maintenance probe was conducted 12 days after the last intervention probe due to scheduling conflicts. Dyads E and F did not complete the intervention before the end of the school year and were therefore unable to complete a maintenance probe. In all maintenance probes, procedures were identical to those in the intervention probes.

Instructional Procedure

When a dyad entered the intervention phase, each participant first received two individual instruction sessions to introduce the app, the play skills, and the hot spots for their target toy set. Once both participants within a dyad had each completed their individual instruction sessions, the participants within that dyad received instruction together for the remainder of the study (dyad instruction sessions). For each dyad, the first intervention probe was conducted during the visit immediately following the first dyad instruction session. Then, throughout the remainder of the intervention phase, each visit included a probe followed by dyad instruction.

Individual instruction sessions. Individual instruction sessions were conducted in order to introduce the participants to the app, the play skills, and the hot spots that would be used throughout the intervention phase of the study. These sessions were intended to ensure that each participant could operate the app (including activating the hot spots) and imitate the video models of the play behaviors before being shown how to apply these skills within the context of a peer play interaction. The sessions followed the same turn-taking format as the probes, except that participants interacted with the researcher rather than their peer partner. In the first session, participants were taught to take turns selecting video VSDs and performing the action depicted within each video. No hot spots were available during this phase. In the second session, participants were taught to both complete the play action in the video and communicate by selecting at least one of the available hot spots. Least-to-most prompting (expectant delay, gesture, model) was used throughout the individual sessions to support participants in selecting play activities, imitating the videos, and using the hot spots as needed. Each participant was required to complete both phases of the individual training before starting dyad instruction.

Dyad instruction sessions. During dyad instruction, the two children took turns selecting and activating the video VSDs following the same format as the probe and individual instruction sessions. The researcher provided least-to-most prompting, if needed, to ensure that (a) the participant whose turn it was used at least one hot spot, (b) the participant whose turn it was completed one part of the play action (e.g., "pouring a drink"), and (c) the other participant completed the second part of the play action (e.g., "spilling the drink"). Practice continued for a total of 20 turns, with turns alternating between the peer and the participant with ASD. Dyad instruction continued throughout the intervention phase, with the exception of Dyad F for which instruction was discontinued after the second intervention probe for reasons related to scheduling. Dyads B and D received instruction directly following each probe. Dyads A, C, E, and F received instruction during a separate visit due to time constraints. Instruction sessions lasted between 10 and 20 min each.

Procedural Reliability

To determine procedural reliability for the probes, a graduate student watched videos of the probes and compared the researcher's performance with the predetermined checklist of steps. A minimum of 25% of all baseline, intervention, and generalization probes for each dyad and a minimum of 25% of all maintenance probes were randomly selected to be coded. Procedural reliability was calculated by dividing the number of steps completed correctly by the total number of steps on the checklist and multiplying by 100 to determine a percentage (Gast & Ledford, 2014). Mean procedural reliability for the probe sessions was 97.8% (range: 88%–100%).

Intervention Integrity

The same graduate student who coded reliability for the probe sessions watched videos of the individual and dyad training sessions and compared the researcher's performance against procedural checklists to determine intervention integrity. A minimum of 25% of the training sessions were randomly selected to be coded (Schlosser, 2002). Intervention integrity was calculated by dividing the number of steps completed correctly by the total number of steps on the checklist and multiplying by 100 to determine a percentage (Gast & Ledford, 2014). Intervention integrity for the training sessions was 99.2% (range: 95%–100%) across all participants and dyads.

Dependent Measures and Data Analysis

All probe sessions were videotaped for later coding. The dependent variable in this study was the number of turns (out of the 10 turns in which the participant with ASD was given the opportunity to select the toys) in which the participant with ASD demonstrated at least one symbolic communication act. Symbolic communication acts included use of a spoken word or intelligible word approximation, a manual sign, a conventional gesture, or activation of a hot spot on the iPad. Communication acts had to be related to conventional use of the toy and directed toward the peer. Communication acts were considered to be directed toward the peer if, within 3 s of the act, the participant (a) looked at the peer or (b) attended to the peer's play action, a shared play action, or jointly attended with the peer to the tablet or photographs.

Coding was completed by two undergraduate students in communication sciences and disorders, both of whom were blind to the study's goals and the treatment condition. Each student was individually trained using videos of mock probe sessions specifically created by the researcher for training purposes. Students were trained until interobserver agreement with the researcher was 100%.

Interobserver Agreement

To determine interobserver agreement for the dependent variable, a third undergraduate student who was blind to the study's goals and phase coded at least 20% of baseline and intervention probes, selected at random, for each dyad. This coder was trained as described previously. Interobserver agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. Mean interobserver agreement for the dependent variable across dyads was 82% (range: 10%–100%). Mean interobserver agreement during the baseline phase across all dyads was 83% (range: 10%–100%), and mean interobserver agreement during the intervention phase across all dyads was 82% (range: 60%–100%). In the case of discrepancies, the scores obtained by the primary coder were used.

Data Analysis

Data were graphed for each participant with ASD, and visual analysis was used to examine the data with respect to level, trend, variability, overlap, and immediacy of effect (Gast & Ledford, 2014; Kratochwill et al., 2013). To determine effect size, Tau-U was calculated using a free Tau-U online calculator (Vannest et al., 2011). A Tau-U score of .2 indicates a small effect size; .2–.6, a moderate effect size; .6–.8, a large effect size; and above .8, a large to very large effect size (Vannest & Ninci, 2015). In addition to Tau-U, gain scores were calculated to determine the magnitude of the effect. Gain scores were calculated by subtracting the average number of turns with symbolic communication in the baseline phase from the average number of turns with symbolic communication in the intervention phase for each participant with ASD.

Social Validity

To determine the social acceptability of the intervention, the teachers of the participants with ASD were asked to share their impressions of the intervention by completing a modified version of the Treatment Acceptability Rating Form–Revised (TARF-R; Reimers et al., 1992). The form included 12 items in a Likert-type format that addressed stakeholders' perceptions of the intervention. While the teachers did not typically attend the study sessions, they were invited to observe a probe session during the intervention phase in order to be able to share feedback on the intervention. Only teachers who were present for an intervention probe completed the form. This included three out of the four teachers who together taught five out of the six participants with ASD. Felicity's teacher was unable to attend any of the study sessions and, therefore, did not provide feedback on the intervention.

Results

Symbolic Communication

Results for Dyads A, B, and C (Ava, Brian, and Caleb) can be found in Figure 2, and results for Dyads D, E, and F (Daniel, Emma, and Felicity) can be found in Figure 3. Overall, the results show an increase in the number turns in which the participant with ASD demonstrated at least one symbolic communication act for all six participants with ASD following introduction of the video VSD intervention, with Tau-U values indicating large to very large effect sizes.

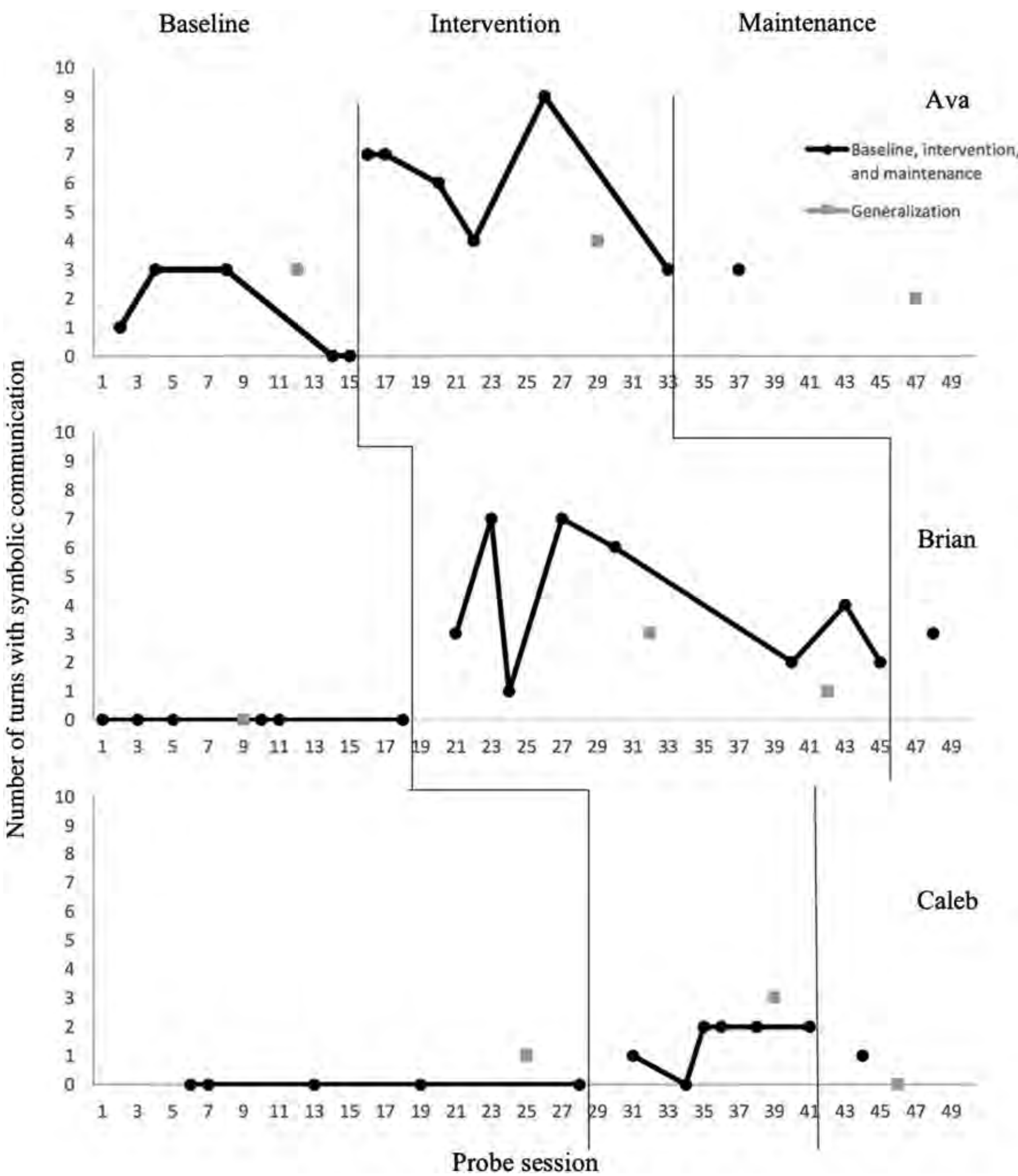
Ava, Brian, and Caleb

During the baseline phase, Ava, Brian, and Caleb all demonstrated low or floor-level performance with steady or decreasing trends and minimal variability. This was followed by an immediate increase in turns with symbolic communication upon introduction of the intervention for all three participants. Increases were maintained throughout the intervention phase with minimal overlap between baseline and intervention data for all three participants, although both Ava and Brian demonstrated variability in performance throughout the intervention phase, and neither participant demonstrated a consistent increasing trend in performance. The variability observed in their performance during the intervention phase may have been impacted by intrinsic variables related to the participant with ASD (e.g., health, mood, motivation) as well as variables related to the peers. Caleb's performance during intervention was less variable, but his gains overall were more modest as compared with gains made by Ava and Brian. Overall, visual analysis of the data with respect to level, trend, variability, overlap, and immediacy of the effect indicates that the intervention had an effect at three different points in time (i.e., across the three dyads); this suggests a functional relation between the number of turns with symbolic communication for the participants with ASD and the video VSD intervention. Ava, Brian, and Caleb received gain scores of +4.6, +4, and +1.5 turns with symbolic communication, respectively. Effect sizes, calculated using Tau-U, were large or very large for all three participants (i.e., .9 for Ava, 1.0 for Brian, and .8 for Caleb).

The generalization results for these participants were mixed. Brian demonstrated an increase in turns with symbolic communication, from 0 out of 10 turns in the generalization probes during the baseline phase to an average of 2 out of 10 turns for the probes in the intervention phase with the novel toy set. Caleb also demonstrated an increase from 1 out of 10 turns in the generalization probes at baseline to an average of 1.5 out of 10 turns during intervention with the new toys; however, it should be noted that his performance in the second generalization probe during the maintenance phase fell below his performance during baseline. Ava's performance did not change across the generalization probes from baseline to intervention; she demonstrated symbolic communication during 3 out of 10 turns in the probes at baseline and in intervention with the novel toys.

During the maintenance probes, all three participants demonstrated a decrease in the number of turns with symbolic communication as compared with their average performance during the intervention phase. It is possible that this reflected the lack of ongoing intervention, boredom with the toys, or distraction due to the approaching end of the school year. In spite of this,

Figure 2. Number of turns in which participants with autism spectrum disorder demonstrated a symbolic communicative act for Ava, Brian, and Caleb.

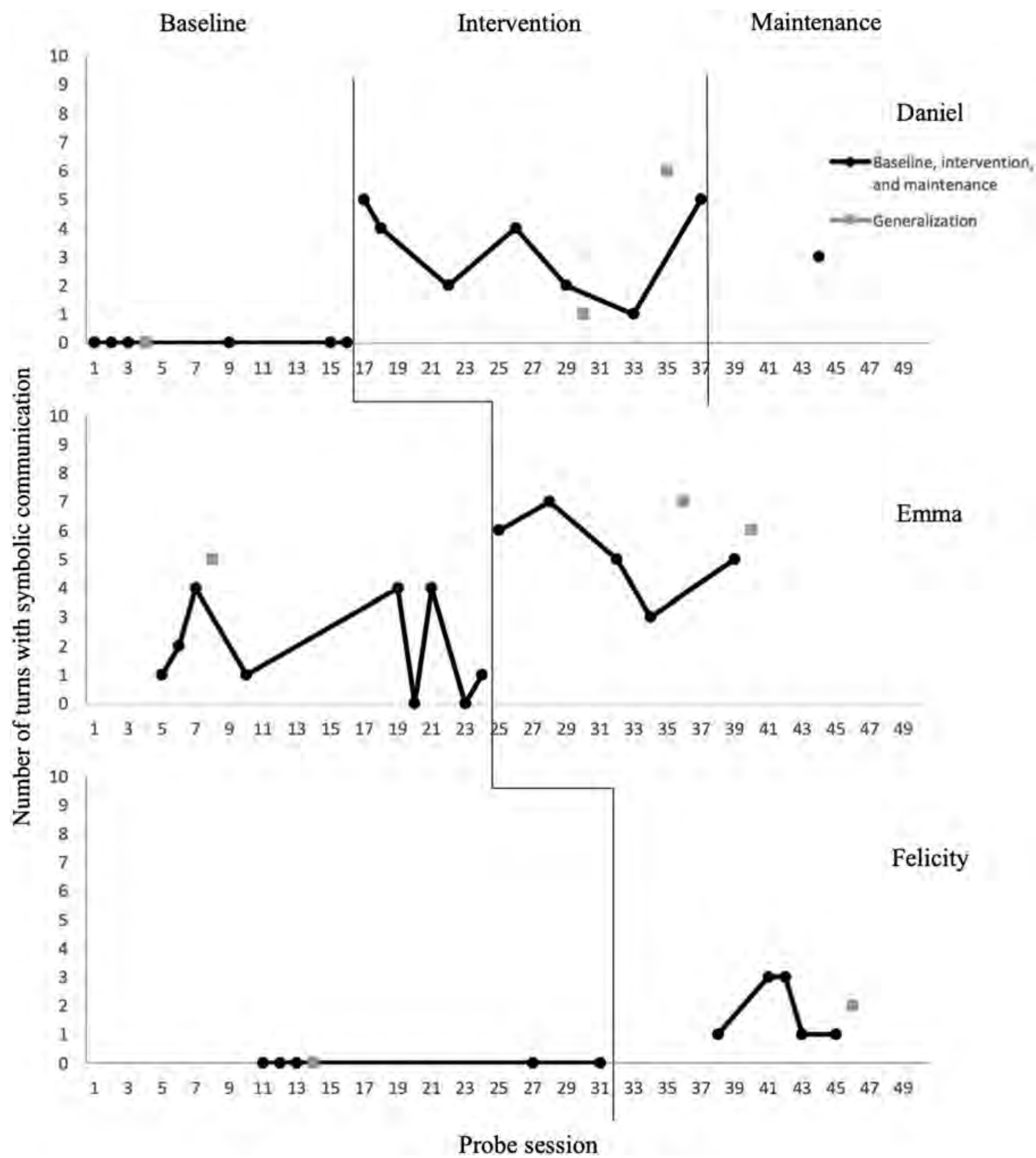


however, performance for all three participants during the maintenance probes remained above the average performance during the baseline phase.

Daniel, Emma, and Felicity

During the baseline phase, Daniel and Felicity both demonstrated floor-level performance with no variability. This was followed by an immediate increase in level of the data upon introduction of the intervention. Performance remained consistently above baseline levels for both participants throughout the intervention phase with no overlap between baseline and intervention data. However, there was some variability in the data for both participants. Daniel demonstrated a large initial increase followed by a slight decreasing trend, in turn followed by a rebound in turn-taking. Felicity demonstrated an initial increasing trend across the first three intervention probes, followed by a decrease

Figure 3. Number of turns in which participants with autism spectrum disorder demonstrated a symbolic communicative act for Daniel, Emma, and Felicity.



during her last two intervention probes. It is possible that these decreases reflected boredom with the toys or procedures as the study progressed. Additionally, the decreases observed for Felicity may have been related to the fact that instruction sessions were discontinued for that dyad after the second intervention probe due to scheduling conflicts. Overall, visual analysis of the data for Daniel and Felicity with respect to level, trend, variability, overlap, and immediacy of effect indicates that the intervention had an effect for both of these participants.

In contrast, the baseline data for Emma demonstrated variability that made it difficult to determine performance levels clearly. As a result, it was difficult to establish a clear effect of the intervention on Emma's symbolic communication. Since an intervention effect was not clearly established across all three participants in this leg, a functional relation between the number of turns with symbolic communication for the participants with ASD (the dependent variable) and the video VSD intervention (the independent variable) could not be established for this leg of the study. Upon introduction of the intervention, Emma showed an immediate increase in level; however, there was a decreasing trend throughout the next three intervention sessions, followed by a return to initial intervention levels of performance. Unlike the other participants with ASD, Emma demonstrated some overlap between baseline and intervention data. Although the data for Emma did not clearly indicate an intervention effect, it is notable that her average performance increased following introduction of the intervention and that four out of five intervention probes exceeded baseline.

Daniel, Emma, and Felicity all demonstrated positive gain scores. Daniel and Felicity received gain scores of +3.3 and +1.8 turns with symbolic communication, respectively. Emma received a gain score of +3.3 turns; however, increases for Emma should be interpreted with caution due to unstable baseline data that make it difficult to determine her typical performance prior to the introduction of the intervention. Effect sizes, calculated using Tau-U, were very large for all three participants (i.e., 1.0 for Daniel, .9 for Emma, and 1.0 for Felicity).

All three participants demonstrated gains during the generalization probes in intervention relative to the generalization probes in baseline. Daniel demonstrated an increase from 0 in the baseline phase to an average of 3.5 out of 10 turns with symbolic communication in the intervention phase, Emma demonstrated a modest increase from 5 out of 10 turns in baseline to an average of 6.5 out of 10 turns with symbolic communication during intervention, and Felicity demonstrated an increase from 0 out of 10 turns in baseline to 2 out of 10 turns in intervention.

Daniel was the only one of these three participants to complete a maintenance probe. He did not maintain the level of performance achieved during the intervention phase, demonstrating symbolic communication during 3 out of 10 turns in his maintenance probe as compared with an average of 3.3 out of 10 turns during intervention. However, his performance during the maintenance probe remained above his average performance during baseline.

Social Validity

Social validity data are provided in Table 2. Overall impressions of the intervention and the app were positive. Of the three teachers (representing five participants with ASD) who completed the TARF-R, all three rated the intervention acceptable, indicated that they were confident that the intervention was effective, and stated that they would be willing to encourage their student to use the technology in the future. While the teachers indicated that discomfort or undesirable side effects due to the intervention were unlikely, one teacher, who taught both Ava and Emma, reported that the length of the intervention was potentially problematic. This may have been due in part to a long baseline phase for Emma and her peer and to the fact that Emma did not demonstrate clear gains as a result of this intervention.

Table 2. Teacher responses to questions on the Treatment Acceptability Rating Form–Revised.

Question	Rating		
	Teacher 1	Teacher 2	Teacher 3
How acceptable did you find the video technology intervention for play and communication skills?	5	4	5
To what extent would you encourage your child/student to use this video technology during play in the future?	5	5	4
To what extent do you think there might have been disadvantages to using this technology during play?	1	2	3
How confident are you that the video technology intervention was effective for your child/student?	5	5	4
How likely is this technology to make permanent improvements in your child/student's communication and play skills?	5	5	3
How much do you like the video technology intervention used in this study?	5	5	3
To what extent did you notice undesirable side effects from this intervention?	1	1	2
How much discomfort did your child/student experience during this intervention?	1	1	1
How willing would you be to change your child/student's routines to incorporate this technology in the future?	5	5	3
How well will using this technology fit into your child/student's existing play opportunities with peers?	4	4	3
How effective was the intervention in teaching your child/student communication and play skills?	4	4	3
How well did the goal of the intervention fit with your goals for your child/student?	4	4	4

Note. Ratings are on a scale of 1 (*not at all/none/unlikely*) to 5 (*very/many/very much*).

Discussion

Effect of the Video VSD Intervention on Communication and Play

Results suggest that this intervention package (including introduction of video VSD technology and instruction in its use) may be effective in increasing the number of turns in which children with ASD demonstrate symbolic communication with peers without disabilities. All six participants with ASD demonstrated gains in performance following introduction of the intervention, with large or very large effect sizes. These gains were demonstrated despite the challenging nature of the task; participants with ASD were learning to communicate during play interactions (which may present challenges for many children with ASD) with peers who not only provided little scaffolding but also may themselves have still been developing cooperative play skills. Furthermore, all of the participants who received CARS scores in the severe range for ASD made gains, indicating that the intervention may be effective even for participants who would have been expected to have the most difficulty with communication during peer play interactions. These results are consistent with those of prior studies that found gains following the introduction of video VSDs to support communication for young children with ASD during interactions with adults (Caron et al., 2018, 2019; Chapin et al., 2021) and peers (Laubscher et al., 2019). This study adds to the evidence that video VSDs may be an effective support for communication during social interactions for children with ASD, even within a challenging social context such as play.

One participant (Emma) made gains following introduction of the intervention, but the benefits of the intervention were not as clear for her as they were for some of the other participants due to variable performance during both baseline and intervention phases and some overlap between her baseline and intervention data. It is interesting to note that Emma demonstrated stronger language and communication skills than the other participants and higher baseline levels of performance than the other participants generally. She already demonstrated some of the skills targeted in the intervention. It is possible that she may have benefited more from an intervention targeting more advanced social skills rather than the current intervention, which provided access to basic language concepts to support communication.

Several elements of the intervention may have contributed to the observed gains across participants. Video VSDs included a video component that may have helped provide context for the communicative interaction (Light et al., 2019). The videos also paused at predetermined moments to reveal a VSD with hot spots for communication (Light et al., 2019). For children with ASD who have difficulty initiating or responding to peers during social interactions such as play, the automatic appearance of the VSD with hot spots may have helped by providing a prompt to communicate at an appropriate moment. The automatic appearance of the preprogrammed hot spots may have further supported communication by providing easy access to relevant vocabulary as well as access to speech output for children with limited speech. Unlike many traditional AAC displays that present vocabulary in rows and columns, the VSDs included hot spots embedded within a meaningful scene, providing context and eliminating the need to navigate through vocabulary options (Light et al., 2019). Additionally, instruction included evidence-based strategies such as systematic prompting and positive feedback (Jung & Sainato, 2013) to teach use of the technology and application of communication skills during interactions.

Efficiency of the Intervention

Increases in participant performance were observed immediately for all participants, following only a short individual training to introduce the app and one 15- to 20-min intervention session with the peer. However, none of the participants demonstrated symbolic communication during all 10 turns in any of the probes. There are several potential explanations for this. It is possible that additional instruction was required for participants to reach mastery. Unfortunately, long-term instruction was not possible within the time constraints of this study due to the end of the school year. It is also possible that participants grew bored of the toys over the course of the study, potentially contributing to a decrease in performance following an initial increase. Only one set of toys was used per dyad to ensure that conditions remained the same across all probes. However, boredom may have contributed to the overall lack of engagement as time went on. In some cases, peers may have grown bored before the participants with ASD. For instance, Caleb demonstrated strong interest in the toys and video VSDs throughout the intervention phase, but his peer partner demonstrated inconsistent engagement, and this may have impacted Caleb's motivation to communicate and interact.

Clinical Implications

All of the teachers who completed the TARF-R reported favorable views of the intervention overall, suggesting potential for positive uptake in the classroom. Given the importance of peer play interactions during childhood and increasing recognition of the need for inclusive educational opportunities, it is encouraging that this intervention successfully provided communication support for the participants with ASD using a platform that also offered support for the peers; that is, the video VSDs provided support for both participants simultaneously to help them play together and communicate with one another (Therrien & Light, 2018). The intervention treated both children as equals, rather than placing the peer in a helper role (Therrien & Light, 2018). Although this intervention provided a platform that was designed to support both participants to interact as equals, it should be noted that data were not collected on peer communication, and it is not possible to determine based on these results whether peer communication was impacted by the intervention.

The encouraging generalization data in this study are consistent with previous studies in which participants generalized gains made following the introduction of video VSDs to novel communication partners or activities (e.g., Babb et al., 2019; Babb, Jung, et al., 2021; Babb, McNaughton, et al., 2021; Chapin et al., 2021). These results suggest that children may be able to use the video VSD app to support communication during a variety of activities given initial instruction within only one activity. It would be relatively easy for classroom teachers and other professionals to create a library of video VSDs for a range of play activities that can then be used to offer children some choice and variety in their play without requiring additional instruction. This may help address the concern expressed by one teacher regarding the length of the intervention in this study; even if students require more initial support, this time investment may translate to improvements across a variety of activities. Because instruction sessions can be conducted in a relatively short amount of time, booster sessions could be provided if needed to support maintenance.

It is interesting to note that only one of the participants with ASD used AAC to support communication prior to the start of the study despite the fact that all participants with ASD had limited speech. This underscores the potential need to improve access to and awareness of AAC options to ensure that all children who may benefit from AAC are provided with appropriate supports.

Limitations and Future Research Directions

Although this study provides preliminary evidence that a video VSD intervention may support communication for children with ASD and limited speech during interactions with peers, several limitations must be acknowledged. The independent variable in this study was an intervention package consisting of AAC technology and instruction. It is not possible to determine the potential contribution of each component of the independent variable (the technology and the instruction) to the observed gains. Future research might aim to address this limitation; for instance, it would be interesting to explore the impact of adding AAC alone (in the absence of additional instruction) on communication during peer interactions, including those that occur in the context of play.

This study is also limited in that it did not measure peer behavior. Previous studies investigating the impact of VSDs or video VSDs on interactions between individuals with ASD and peers have found that the introduction of VSD or video VSD technology had a positive impact on the frequency of communication of the peers as well as the participants with ASD (Babb, McNaughton, et al., 2021; Therrien & Light, 2018). However, these studies were not conducted within a play context. Future research would help determine the potential impact of the intervention on the communication of the peers, as well as any potential influence of peer performance on that of the participants with ASD.

Probe and instruction sessions were conducted outside of the classroom, and an adult helped facilitate turn-taking and manage the toys. Additionally, although this study examined generalization to new toys, it did not consider generalization to naturalistic play contexts. Future research should explore the feasibility of the current intervention within a classroom environment where instructor availability might be limited and play interactions may be more likely to be open ended and child driven than adult facilitated.

There was a short gap between the last baseline probe and the first intervention probe for Dyad F due to scheduling conflicts. This gap represents approximately 2 weeks of time during which performance was not measured. It is not possible to rule out changes in performance that may have occurred during this time as a result of factors unrelated to the independent variable; however, such changes are unlikely given that performance remained consistently at floor levels throughout the 4-week baseline phase for this dyad. Additionally, due to the end of the school year, instruction was discontinued for Dyad F following the second intervention probe; results for this dyad should be interpreted with caution due to the limited instruction provided. The lack of maintenance data for Dyads E and F is also a limitation.

Although interobserver agreement for the study overall and for each phase of the study individually was above 80%, there was one session from each phase in which agreement was lower. It is hypothesized that this was due to coder error. Follow-up training for the coder may have helped address these errors, but unfortunately, it was not possible to provide additional training due to a lack of coder availability. Despite the lower values for these two sessions, average interobserver agreement remained within an acceptable range, with high scores for most other sessions.

Finally, a major limitation of this study was a lack of input from the direct consumers (the children with ASD and the peers) regarding the intervention. While the intention was to elicit information about their preferences using a forced-choice task following the completion of the study, this was not possible due to scheduling conflicts and the end of the school year. Moreover, while input regarding the intervention was sought from the teachers of the participants with ASD, the teacher for one participant (Felicity) did not provide input.

Conclusions

The results of this study provide preliminary evidence that an intervention package consisting of video AAC technology and instruction can increase the number of turns in which children with ASD demonstrate symbolic communication with their peers without disabilities. This technology holds promise for enhancing play interactions between children with ASD and their peers in inclusive classroom environments. Additional research is needed to identify critical elements of the intervention package, to determine the optimal amount of instruction, and to extend the intervention to more naturalistic contexts.

Data Availability Statement

All data supporting the results of this study are documented within this article.

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References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Babb, S., Gormley, J., McNaughton, D., & Light, J. (2019). Enhancing independent participation within vocational activities for an adolescent with ASD using AAC video visual scene displays. *Journal of Special Education Technology, 34*(2), 120–132. https://doi.org/10.1177/0162643418795842

Babb, S., Jung, S., Ousley, C., McNaughton, D., & Light, J. (2021). Personalized AAC intervention to increase participation and communication for a young adult with Down syndrome. *Topics in Language Disorders, 41*(3), 232–248. https://doi.org/10.1097/TLD.0000000000000240

Babb, S., McNaughton, D., Light, J., & Caron, J. (2021). "Two friends spending time together": The impact of video visual scene displays on peer social interaction for adolescents with autism spectrum disorder. *Language, Speech, and Hearing Services in Schools, 52*(4), 1095–1108. https://doi.org/10.1044/2021_LSHSS-21-00016

Boudreau, J., & Harvey, M. T. (2013). Increasing recreational initiations for children who have ASD using video self modeling. *Education and Treatment of Children, 36*(1), 49–60. https://doi.org/10.1353/etc.2013.0006

Caron, J., Holyfield, C., Light, J., & McNaughton, D. (2018). "What have you been doing?": Supporting displaced talk through augmentative and alternative communication video visual scene display technology. *Perspectives of the ASHA Special Interest Groups, 3*(12), 123–135. https://doi.org/10.1044/persp3.SIG12.123

Caron, J., Laubscher, E., Light, J., & McNaughton, D. (2019). *Effect of video VSDs on communicative turns of individuals with autism spectrum disorder and complex communication needs* [Manuscript submitted for publication].

Chang, Y.-C., Shih, W., & Kasari, C. (2016). Friendships in preschool children with autism spectrum disorder: What holds them back, child characteristics or teacher behavior? *Autism, 20*(1), 65–74. https://doi.org/10.1177/1362361314567761

Chapin, S. E., McNaughton, D., Light, J., McCoy, A., Caron, J., & Lee, D. L. (2021). The effects of AAC video visual scene display technology on the communicative turns of preschoolers with autism spectrum disorder. *Assistive Technology*. https://doi.org/10.1080/10400435.2021.1893235

Charlop, M. H., Lang, R., & Rispoli, M. (2018). *Play and social skills for children with autism spectrum disorder*. Springer Cham. https://doi.org/10.1007/978-3-319-72500-0

Dunn, L., & Dunn, L. (2004). *Peabody Picture Vocabulary Test–Fourth Edition*. AGS.

Fenson, L., Marchman, V. A., Thal, D. J., Dale, P. S., Reznick, J. S., & Bates, E. (2007). *The MacArthur–Bates communicative development inventories: User's guide and technical manual* (2nd ed.). Brookes.

Finke, E. H. (2016). Friendship: Operationalizing the intangible to improve friendship-based outcomes for individuals with autism spectrum disorder. *American Journal of Speech-Language Pathology, 25*(4), 654–663. https://doi.org/10.1044/2016_AJSLP-15-0042

Fragale, C. (2014). Video modeling interventions to improve play skills of children with autism spectrum disorders: A systematic literature review. *Review Journal of Autism and Developmental Disorders, 1*(3), 165–178. https://doi.org/10.1007/s40489-014-0019-4

Ganz, J. (2015). AAC interventions for individuals with autism spectrum disorders: State of the science and future research directions. *Augmentative and Alternative Communication, 31*(3), 203–214. https://doi.org/10.3109/07434618.2015.1047532

Garrison-Harrell, L., Kamps, D., & Kravits, T. (1997). The effects of peer networks on social-communicative behaviors for students with autism. *Focus on Autism and Other Developmental Disabilities, 12*(4), 241–256. https://doi.org/10.1177/108835769701200406

Gast, D. L., & Ledford, J. R. (2014). *Single case research methodology: Applications in special education and behavioral sciences* (2nd ed.). Routledge. https://doi.org/10.4324/9780203521892

Jung, S., & Sainato, D. M. (2013). Teaching play skills to young children with autism. *Journal of Intellectual & Developmental Disability, 38*(1), 74–90. https://doi.org/10.3109/13668250.2012.732220

Kratochwill, T. R., Hitchcock, J. H., Horner, R. H., Levin, J. R., Odom, S. M., Rindskopf, D. M., & Shadish, W. R. (2013). Single-case intervention research design standards. *Remedial and Special Education, 34*(1), 26–38. https://doi.org/10.1177/0741932512452794

Laubscher, E., Light, J., & McNaughton, D. (2019). Effect of an application with video visual scene displays on communication during play: Pilot study of a child with autism spectrum disorder and a peer. *Augmentative and Alternative Communication, 35*(4), 299–308. https://doi.org/10.1080/07434618.2019.1699160

Light, J., McNaughton, D., & Caron, J. (2019). New and emerging AAC technology supports for children with complex communication needs and their communication partners: State of the science and future research directions. *Augmentative and Alternative Communication, 35*(1), 26–41. https://doi.org/10.1080/07434618.2018.1557251

Light, J., McNaughton, D., & Jakobs, T. (2014). *Developing AAC technology to support interactive video visual scene displays*. RERC on AAC: Rehabilitation Engineering Research Center on Augmentative and Alternative Communication. https://rerc-aac.psu.edu/archives-2014-2020/d2-developing-aac-technology-to-support-interactive-video-visual-scene-displays/

Lory, C., Rispoli, M., & Gregori, E. (2018). Play interventions involving children with autism spectrum disorder and typically developing peers: A review of research quality. *Review Journal of Autism and Developmental Disorders, 5*(1), 78–89. https://doi.org/10.1007/s40489-017-0124-2

MacDonald, R., Sacramone, S., Mansfield, R., Wiltz, K., & Ahearn, W. (2009). Using video modeling to teach reciprocal pretend play to children with autism. *Journal of Applied Behavior Analysis, 42*(1), 43–55. https://doi.org/10.1901/jaba.2009.42-43

Reimers, T. M., Wacker, D. P., Cooper, L. J., & de Raad, A. O. (1992). Acceptability of behavioral treatments for children: Analog and naturalistic evaluations by parents. *School Psychology Review, 21*(4), 628–643. https://www.tandfonline.com/doi/abs/10.1080/02796015.1992.12087371

Scheflen, S. C., Freeman, S. F. N., & Paparella, T. (2012). Using video modeling to teach young children with autism developmentally appropriate play and connected speech. *Education and Training in Autism and Developmental Disabilities, 47*(3), 302–318. https://www.jstor.org/stable/23879967

Schlosser, R. W. (2002). On the importance of being earnest about treatment integrity. *Augmentative and Alternative Communication, 18*(1), 36–44. https://doi.org/10.1080/aac.18.1.36.44

Schlosser, R. W., & Koul, R. K. (2015). Speech output technologies in interventions for individuals with autism spectrum disorders: A scoping review. *Augmentative and Alternative Communication, 31*(4), 285–309. https://doi.org/10.3109/07434618.2015.1063689

Schopler, E., Reichler, R. J., & Renner, B. R. (1988). *The childhood autism rating scale*. Western Psychological Services.

Schuler, A., & Wolfberg, P. (2000). Promoting peer play and socialization: The art of scaffolding. In A. Wetherby & B. Prizant (Eds.), *Autism spectrum disorders: A transactional developmental perspective* (pp. 251–277). Brookes.

Tager-Flusberg, H., & Kasari, C. (2013). Minimally verbal school-aged children with autism spectrum disorder: The neglected end of the spectrum. *Autism Research, 6*(6), 468–478. https://doi.org/10.1002/aur.1329

Tager-Flusberg, H., Rogers, S., Cooper, J., Landa, R., Lord, C., Paul, R., Rice, M., Stoel-Gammon, C., Wetherby, A., & Yoder, P. (2009). Defining spoken language benchmarks and selecting measures of expressive language development for young children with autism spectrum disorders. *Journal of Speech, Language, and Hearing Research, 52*(3), 643–652. https://doi.org/10.1044/1092-4388(2009/08-0136)

Therrien, M., & Light, J. (2018). Promoting peer interaction for preschool children with complex communication needs and autism spectrum disorder. *American Journal of Speech-Language Pathology, 27*(1), 207–221. https://doi.org/10.1044/2017_AJSLP-17-0104

Trembath, D., Balandin, S., Togher, L., & Stancliffe, R. J. (2009). Peer-mediated teaching and augmentative and alternative communication for preschool-aged children with autism. *Journal of Intellectual & Developmental Disability, 34*(2), 173–186. https://doi.org/10.1080/13668250902845210

Trottier, N., Kamp, L., & Mirenda, P. (2011). Effects of peer-mediated instruction to teach use of speech-generating devices to students with autism in social game routines. *Augmentative and Alternative Communication, 27*(1), 26–39. https://doi.org/10.1044/1092-4388

Vannest, K. J., & Ninci, J. (2015). Evaluating intervention effects in single-case research designs. *Journal of Counseling & Development, 93*(4), 403–411. https://doi.org/10.1002/jcad.12038

Vannest, K. J., Parker, R. I., & Gonen, O. (2011). *Single case research: Web based calculators for SCR analysis* (Version 1.0) [Web-based application]. Texas A&M University. http://www.singlecaseresearch.org

Wolfberg, P., DeWitt, M., Young, G. S., & Nguyen, T. (2015). Integrated play groups: Promoting symbolic play and social engagement with typical peers in children with ASD across settings. *Journal of Autism and Developmental Disorders, 45*(3), 830–845. https://doi.org/10.1007/s10803-014-2245-0

Appendix

Toys, Play Actions, and Hot Spots

Toy	Props	Play actions[a]	Hot spots
Food	Orange, cutting board, knife	Hold/cut orange	Orange, cut
	Frying pan, bacon, spatula	Stir/flip bacon	Flip, uh oh
	Pitcher, cup	Pour/spill drink	Spill, oops
	Toaster, toast	Toast in toaster/pop toast	Toast, pop
	Plates, waffles	Share/eat waffles	Waffle, yum
Pets	Dog, scissors, razor	Trim/shave dog	Cut, buzz
	Dog, soap, sponge	Squeeze soap/wash dog	Soap, wash
	Dog, bowl, treats	Food in bowl/make dog eat	Treats, crunch crunch
	Dog	Walk/pat dog	Pat, good boy
	Dog, brush	Brush dog/brush dog	Brush, dog
Cars	Garage, car	Drive car/pump gas	Car, gas
	Garage, car	Raise lift/park car	Up, park
	Garage, car	Open gate/exit garage	Open, go
	Two cars	Drive/crash cars	Drive, crash
	Garage, car	Enter car wash/drive through	Carwash, clean

[a]Role 1/Role 2.