LSHSS

Research Article

"Two Friends Spending Time Together": The Impact of Video Visual Scene Displays on Peer Social Interaction for Adolescents With Autism Spectrum Disorder

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Purpose: Social interaction poses many challenges for adolescents with autism spectrum disorder (ASD) and complex communication needs. The purpose of this study was to investigate the impact of video visual scene displays (video VSDs) on communication during interactions between adolescents with ASD and peer partners.
Method: This study used an across-participant multiple-baseline single-case experimental design. Four adolescents with ASD and complex communication needs were taught to use video VSDs, presented on a tablet-based app, during social interactions with peer partners in a high school setting. The video VSDs used during the interactions were selected (and programmed with vocabulary) based on the interests of the adolescent with ASD and their peer partner.
Results: Following the introduction of the video VSD intervention, all four adolescents with ASD demonstrated an increase in communicative turns compared to baseline (Tau-*U*= 1.0, 95% CI [0.56, 1]), and all four increased in modes of communication used. Increased use of speech also was observed for the three participants who made use of speech prior to the intervention. All participants with ASD (and their peer partners) expressed an interest in continued use of the video VSD app to support social interaction.
Conclusion: The use of video VSDs may be a viable option to increase the participation and communication of adolescents with ASD during social interactions with peer partners.
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Many adolescents with autism spectrum disorder (ASD) experience difficulty participating in social interactions with their peers (Lasgaard et al., 2010), and adolescents with ASD are 5 times more likely to describe themselves as "often or always" feeling lonely than are adolescents without ASD (Lasgaard et al., 2010). Supporting communication with peers can pose many challenges for speech-language pathologists (SLPs) who provide services for adolescents with autism (Bambara et al., 2016; Waller et al., 2016). As children enter adolescence, communication demands are intensified as spoken exchanges increase in both speed and quantity (Turkstra et al., 2003). Conversations typically take place in fast-paced discussions, within small groups of communication partners (Rubin et al., 2011; Turkstra et al., 2003). In contrast to the topics of childhood interaction, social exchanges become more complicated during adolescence, as the understanding of (and communication about) one's self and others intensifies (M. M. Smith, 2015).

ASD and Social Interaction

During typical peer interactions, adolescents talk about a topic of shared interest (Bagwell & Schmidt, 2011), make use of specialized vocabulary that helps to define membership in the group (M. M. Smith, 2015), and share conversational responsibility by taking turns within the interaction (Turkstra et al., 2003). Deficits in social interaction skills are a defining characteristic of ASD (American Psychiatric Association, 2013), however, and many persons with ASD experience challenges in sharing information about a past or future event (Favot et al., 2019), using relevant vocabulary at appropriate times (Neely et al., 2016), and taking appropriate conversational turns during interactions with others (Paul et al., 2009).

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The challenges of social interaction are further intensified for those adolescents with ASD who also have *complex communication needs*: that is, their speech does not meet all of their communication needs (Beukelman & Light, 2020). Approximately 30% of children with ASD do not develop speech (or demonstrate only limited speech) by age 9 years, and many of these individuals continue to experience severe difficulty in using speech during adolescence and adulthood (Tager-Flusberg & Kasari, 2013). Without access to an effective method of communication, these individuals often experience difficulty in participating in an interaction—the speaking partner frequently takes a greater number of communication turns, and dominates the communication exchange (Feldman et al., 2016). As a result, adolescents with ASD experience limited success in communication opportunities in educational, vocational, and recreational activities, and frequently report feelings of social isolation and depression (M. M. Smith, 2015).

Augmentative and Alternative Communication

For individuals with ASD and complex communication needs, the use of *augmentative and alternative communication* (AAC), such as sign language, picture communication boards, and AAC apps on mobile technology, can support both expressive and receptive communication (Ganz et al., 2012, 2014). AAC has been demonstrated to be an important support for communication for persons with ASD in a variety of contexts (e.g., Ganz et al., 2012). Many individuals with ASD and complex communication needs use a variety of methods to communicate (e.g., AAC app, signs, gestures), sometimes using AAC or speech alone, and sometimes using AAC in combination with speech, depending on the nature of the interaction and other factors (Ganz et al., 2014).

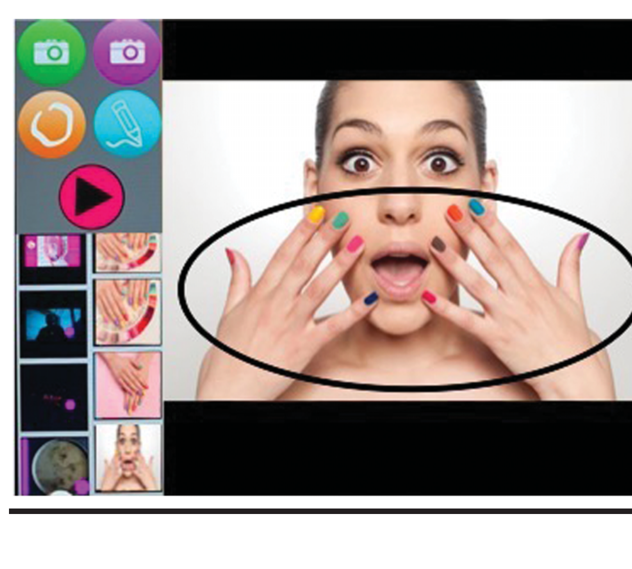
The majority of the research to date, however, has focused on the communication of needs and wants, with only minimal attention to supporting social interaction (Ganz et al., 2012). At the same time, recent reviews of the literature provide evidence that social communication interventions for adolescents with ASD have not addressed the needs of individuals with ASD who have complex communication needs (Babb, Raulston, et al., 2020; Ganz et al., 2012), and there is only a limited understanding of how AAC might support participation in adolescent conversations.

For adolescents with ASD and complex communication needs, the dual challenges of both peer interaction and the use of AAC may pose three key difficulties: (a) the individual with ASD may require language and cognitive supports to discuss past and future events (i.e., events outside the here and now; Adamson & Bakeman, 2006; Caron et al., 2018), (b) the AAC system may not provide easy access to the specialized vocabulary needed for a specific topic, and (c) the rapid exchanges typical of peer interaction may make it difficult for the individual to recognize and take a communication turn (Rubin et al., 2011; M. M. Smith, 2015).

Video Visual Scene Displays

In order to address the challenges of peer interaction for adolescents with complex communication needs, researchers (Babb et al., 2019, Babb, McNaughton, et al., 2020; Light et al., 2019) have investigated the use of *video visual scene displays* (video VSDs). In this approach, first proposed by Light et al. (2014), personally relevant videos are programmed (using an app) with VSDs. To create a VSD, the adolescent with complex communication needs views the video with a partner, pausing the video at key moments (i.e., high-interest events). Pausing the video automatically creates a still photo image of the key event as a VSD. *Hotspots* (i.e., a part of the screen that produces speech output when touched) are added by drawing on the image and recording desired speech output. Once a VSD with one or more hotspots has been added to a video, the video automatically pauses at these key junctures, and the individual has an opportunity to use the hotspots to communicate about the still image that appears. Figure 1 provides an example of a video VSD created for an adolescent with complex communication needs who had a strong interest in the use of colorful nail polish. As the adolescent viewed the video of a woman applying nail polish, it would pause automatically wherever a VSD had been made (e.g., a VSD showing the brightly painted nails). When a hotspot was added on the VSD of the nails, the outline of the hotspot was displayed momentarily and the adolescent could access the prerecorded phrase (e.g., "Beautiful!") by touching the hotspot (see Figure 1).

Figure 1. An example of a custom visual scene display (VSD) created within EasyVSD. The large right area is the location where the videos with VSDs are displayed. The left menu includes options for navigating to different videos, pausing/playing videos, and adding new hotspots to the VSDs. At key moments of interest (e.g., person displaying their nail design), the video can be paused, automatically creating a still image as a VSD, and hotspots can be added with vocabulary related to the event (e.g., "Beautiful!").



Prior Research

Past research has demonstrated the benefits of a video VSD approach to increase social interaction for preschoolers with ASD (Chapin et al., 2021), to support literacy instruction for an adolescent with cerebral palsy (Mandak et al., 2020), and to support participation and communication for adolescents with ASD and/or intellectual and development disabilities while volunteering at a food bank (Babb, McNaughton, et al., 2020). The limited research to date provides evidence that the use of video VSDs holds potential as a social interaction support for individuals with ASD. Additionally, Caron et al. (2021) investigated the use of video VSDs to support social interaction between adolescents with ASD and complex communication needs and adult partners while watching videos. After the introduction of the video VSD app, all five participants demonstrated increases in the number of communicative turns, and in the use of the vocabulary provided through the VSDs.

Although the results are promising, Caron et al. (2021) did not address the use of same-age peers as communication partners—all interactions took place with a skilled adult communication partner (i.e., a certified SLP with extensive experience in the programming of AAC devices, including video VSDs). At present, it is unclear what instructional supports might be needed for a same-age peer to collaboratively create and use video VSDs during social interactions with an adolescent with ASD and complex communication needs. The issue of instruction is a key consideration in social skills interventions: provision of instruction for both the student with disabilities and the peer partner appears to be strongly associated with successful results (Kasari & Smith, 2013; Watkins et al., 2015).It is important, however, to identify supports that require only limited instruction, so as to minimize the role of adults (e.g., teachers, paraprofessionals) during peer interaction (Rubin et al., 2011).

This Study

A video VSD intervention may offer a promising approach to the key challenges of peer interaction for adolescents with ASD, as the video VSD app (a) provides a context to support interaction about events and activities outside the here and now, (b) supports easy access to needed vocabulary at appropriate times, and (c) provides clear cues for the taking of conversational turns. It also was hypothesized that because the app is relatively simple to use, that only a relatively brief training (including a small number of video models of its expected use) would contribute to a change in interaction behaviors between adolescents with ASD and peer communication partners. This study, therefore, addressed three questions: (a) What is the effect of a video VSD intervention on the frequency of communication turns of adolescents with ASD and complex communication needs during interactions with peers with typical development? (b) What is the effect of a video VSD intervention on the frequency of communication turns of peers with typical development and adolescents during interactions with adolescents with ASD and complex communication needs? (c) How is the video VSD intervention viewed by key stakeholders in terms of social validity and its effectiveness as support for social interaction?

Method

Research Design

This study used a single-subject, multiple-probe, across-participants design across four dyads (Kazdin, 2013). In this design, the researcher measures a single target behavior for multiple individuals. After establishing a stable baseline (i.e., minimal to no increasing trend; J. D. Smith, 2012) and at least five sessions for each participant, the independent variable is introduced to the first participant while the other participants remain in baseline. When the first participant meets the set criterion for an intervention effect (two consecutive data points at least 25% higher than the highest baseline probe; Caron et al., 2021) for the activity, the independent variable is introduced to the next participant while the third participant remains in baseline. The sequence continues until the independent variable has been introduced to all participants (Cooper et al., 2007). This design investigates whether the behaviors (i.e., dependent variable) of the participants change upon introduction of the intervention (the independent variable, in this case, the video VSD technology), thereby showing a relationship between the intervention and the targeted skill (Kazdin, 2013). In this study, Participants 3 and 4 were yoked together in order to prevent an extended period in baseline (and the approaching end of the school year), and therefore, entered intervention at the same time (Kazdin, 2013). The study involved three phases, baseline, intervention, and maintenance, with generalization probes conducted during baseline and intervention. The independent variable was a multicomponent intervention including the provision of a tablet computer with the video VSD app, and a single training session for each dyad in the use of the app. The primary dependent variable was the frequency of symbolic communicative turns taken by the participants during a 10-min interaction with a peer partner. We also collected data on two collateral variables: the frequency of turns taken by the peer participants, and the mode of communication used by the participants with ASD. The human research ethics committee at the first author's university, and the participating school district, provided approval for the study. Informed consent was obtained for all participants from their parents or legal guardians, as appropriate. Pseudonyms are used for all participants. The first author served as the interventionist for all assessment and intervention activities.

Participants

All participants were recruited from a high school in Pennsylvania. Based on discussions with the school district's Special Education Director and Autism support teachers, students with ASD were recommended as potential participants. Participants with ASD were eligible for inclusion if they met the following criteria: (a) had a diagnosis of ASD; (b) were between the ages of 13–21 years; (c) had speech that was inadequate to meet their daily communication needs as described by their teacher or speech language pathologist; (d) used at least 25 spoken words, signs, or graphic symbols to communicate; (e) experienced difficulty interacting with peers without adult support; (f) had sufficient motor control to use direct selection on a touch screen; (g) watched videos on social media sites (e.g., YouTube; per teacher report); (h) lived in a home in which English was the first language; and (i) demonstrated unimpaired/corrected vision and motor skills and hearing within normal limits per Individualized Education Program or parental/teacher report.

All four of the participants had a diagnosis of ASD (described in the Individualized Education Program as receiving services for students with ASD and corroborated through assessment with the Childhood Autism Rating Scale–Second Edition [CARS-2]; Schopler et al., 2010; administered by the interventionist) and scored in the severe range on the CARS-2, Standard Form (see Table 1). Each participant scored below the first percentile for both the Receptive and Expressive One-Word Picture Vocabulary Tests–Fourth Edition (Brownell, 2010; administered by the interventionist). Participant scores for communication, daily living skills, and socialization as measured by the interventionist using the Vineland–3 (Sparrow et al., 2016) ranged from low (Nick, Wayne, and Lexi) to adequate (Deidre).

All four participants communicated primarily for the purposes of requesting per teacher and SLP report. Each was described as rarely if ever participating in social interactions with peers or staff, and would engage in simple greetings only when prompted to do so. See Supplemental Material S1 for an extended description of participant communication.

Deidre and Lexi relied on the use of natural speech, but typically only when prompted to do so. Their speech often demonstrated the features of immediate and delayed echolalia. According to teacher reports, low-tech AAC supports had been recommended for Deirdre and Lexi in the elementary grades, but had been discontinued as both were described as making little or no use of these systems. Neither Deidre nor Lexi had AAC supports at the time of the study.

Both Nick and Wayne had been provided with AAC systems for expressive communication (i.e., an iPad with communication apps and a low-tech communication book) and receptive communication (i.e., visual schedules). Both used their expressive AAC systems for requesting, primarily only when prompted. Visual schedules were used with both Nick and Wayne throughout the day to support their understanding of the daily routine. Nick made some limited use of speech, primarily for the purposes of requesting. His speech also demonstrated the features of immediate and delayed echolalia. Wayne did not make any use of speech.

The four participants with ASD attended special education classes with one-to-one support throughout the day, and all received speech and language services. Deidre and Lexi participated in general education classes with peers for specials such as cooking, painting, and jewelry making. Nick and Wayne did not participate in any general education classes.

Peer partners without disabilities were recruited based primarily on teacher recommendation. Teachers recommended peers who had some involvement with their students (e.g., participated in school wide Best Buddies program; Best Buddies, n.d.) or volunteered for Special Olympics; Special Olympics, 2021). Peer partners were eligible for inclusion if they met the following criteria: (a) were high school students and (b) had adequate vision or hearing (with or without correction). The peer participants were recruited from the same high school as the participants with ASD.

There were no financial or nonfinancial incentives offered to the participants with ASD or their peer partners. Once informed consent had been obtained from the parent and/or guardian of a potential participant, the interventionist met with the potential participant to explain the goals and time commitment for the study. All individuals provided their assent to participate at that time. Four participants with

Table 1. Participant demographics.

Participant	Age/gender	Communication modes and supports	CARS-2 ST raw score (severity)	Vineland-3 ABC standard score (adaptive level)	ROWPVT percentile score	EOWPVT percentile score	Peer, age, and gender
Deidre	16/F	Delayed echolalia; limited speech	35 (severe)	96 (adequate)	< 1	< 1	Emily/15/F
Nick	16/M	iPad with communication apps (Proloquo2go, Assistive Express); low-tech communication book; immediate and delayed echolalia; visual schedules	45.5 (severe)	57 (low)	< 1	< 1	Sam/17/M
Wayne	17/M	iPad with communication apps (Proloquo2go, Assistive Express); low-tech communication book; visual schedules	45 (severe)	55 (low)	< 1	< 1	Megan/15/F
Lexi	18/F	Immediate and delayed echolalia; limited speech	37.5 (severe)	78 (moderately low)	< 1	< 1	Kristen/17/F

Note. CARS-2 ST = Childhood Autism Rating Scale–Second Edition, Standard Form; ROWPVT = Receptive One-Word Picture Vocabulary Test; EOWPVT = Expressive One-Word Picture Vocabulary Test; F = female; M = male.

ASD and four peers without disabilities were recruited to participate in the study, a total of four dyads.

Setting and Activity

The study took place in the participants' high school. The research activity occurred both in common areas (e.g., designated student meeting places throughout the school) as well as in students' classrooms, and all activities took place during typical school hours (e.g., homeroom, break period). Locations were selected based on space availability and scheduling constraints, and the same settings were used a comparable number of times in both baseline and intervention conditions for each participant.

Materials

Videos

Each tablet contained five video clips, each of which was approximately 2 min in length. The clips were created from videos downloaded from online video-sharing platforms (e.g., YouTube). Video clips were selected based on the interests of the participant and the peer, as identified by the results of a preference assessment (Cooper et al., 2007) conducted prior to the start of the study. The preference assessment included both open-ended (i.e., fill-in-the-blank) and close-ended (i.e., identification of preferred topics from a list) options. For participants with ASD, the preference assessment was completed with a teacher or a parent. The peers completed the preference assessment independently and e-mailed their responses to the interventionist. Based on the interests of the participant with ASD and peer, five videos were selected. Each dyad had a different set of videos based on the interests of the dyad participants. Preferred videos included popular activities such as cooking videos, music videos, TV shows, cartoons, and movie clips. The five video clips were uploaded into the video VSD app, and totaled a minimum of 10 min in length. The same five videos were used in all three phases of the study. The video clips were added to the video VSD app prior to the start of the study.

Tablet and Video VSD App

A 12-in. Samsung Galaxy Note Pro7[1] tablet was provided to each dyad during all sessions of the study. Each tablet contained the EasyVSD[2] app (v. 1.58 created by InvoTek), which was used in all three phases of the study. During all phases, the app provided a vertical menu bar on the left side of the screen with thumbnails representing five videos—touching the thumbnail resulted in the video being played. During intervention and maintenance, the video VSD app also included a menu bar with five buttons that provide editing features (see Figure 1). Only two of the five buttons were used in this intervention.

A four-step process was used to create a VSD: (a) press the play/pause button (the arrow located at the top left, which toggles between a play and pause function depending on the status of video) to begin watching the video clip; (b) use the play/pause button to pause the video at key moments of interest to create a VSD; (c) add hotspots to the image (i.e., press the button that looks like a roughly drawn circle) and add a hotspot on the image, then record communication with a message related to the event that will be spoken when selected; (d) press the play/pause button again to continue watching the video model; (e) repeat Steps 1–4 for the remainder of the video. In addition, a second menu bar (directly to the right of the first) included thumbnails of specific VSDs within the target video, allowing for navigation between parts of the video. When viewed by the participants, the selected video filled 80% the screen of the tablet, while the navigation icons and a play/pause button positioned vertically on the left-hand side of the screen filled the remaining 20% of the screen (as illustrated in Figure 1).

Procedure

The study was implemented over an 11-week period and probes were conducted between 2 and 3 times per week. The probes in all three phases of the study (i.e., baseline, intervention, maintenance) followed the same procedures.

Probe Activities

The participant and the peer were seated next to each other in a quiet area and provided with a tablet that included five 2-min video clips of preferred videos (a total of approximately 10 min of videos). Current AAC supports were also available (e.g., low-tech communication books, access to their AAC apps on the iPad) if they had been recommended for the participant. The interventionist gave an initial cue at the start of the activity: "Now is a time for you to watch and talk about some videos together. You can watch different videos that have been stored on this tablet. We would like you to do this for 10 min." After 10 min had passed, the interventionist announced the session was over, and removed the tablet. All sessions were video-recorded for data collection purposes. A minimum of five baseline sessions and interventions sessions were conducted for each dyad (Kazdin, 2013).

Baseline

Prior to the first baseline probe session, the participants (each dyad) sat together and viewed a 35-s point-of-view video model (labeled Tablet Use) depicting how to use the table. The video demonstrated pressing play/pause and selecting thumbnails to choose videos. Immediately after viewing the Tablet Use video, the first baseline session began. The dyads had access to the same five videos that were used throughout the study for their dyad; however, during baseline, the videos did not include VSDs (and hotspots),

[1]Samsung Galaxy Note Pro 7 is an Android tablet computer, developed by Samsung Electronics. http://www.samsung.com.

[2]EasyVSD is an AAC application created by InvoTek, Inc. http://www.invotek.org/. Although the application used in this study (EasyVSD) was only available for research purposes, GoVisual is a commercially available app that supports the use of video VSDs.

and the participants did not receive any instruction in adding VSDs and hotspots.

Intervention

Prior to the first intervention probe, the participants in each dyad viewed a second instructional video together (labeled App Use) that included two segments: Using the App to Communicate, and Adding Vocabulary to the App.

The Using the App to Communicate segment provided a video model of using the app with a partner. More specifically, participants in each dyad were directed to (a) provide wait time for their partner to take a turn, (b) respond to their partner's turn, and (c) expand on the turn with an additional question or comment. For each target behavior (i.e., wait, respond, expand), a brief video example of the behavior was shown, along with a voice narration describing the behavior. The Adding Vocabulary segment provided a video model of how to work with a partner to create VSDs and add vocabulary using hotspots. The steps were summarized by the acronym START (adapted from Caron et al., 2016): S–Stop the video at an interesting point, T–Talk through where to draw the hotspot and what the hotspot should say, A–Add a hotspot, R–Record the hotspot, and T–Together use the hotspots. The total viewing time for the App Use video was 3 min and 25 s. Other than viewing the instructional video, the dyads received no additional instruction or directions from the interventionist. All dyads viewed each video 1 time only.

The intervention probe occurred exactly as the probes in baseline, except the dyad had access to the video VSD app that supported the addition of VSDs and hotspots to the videos. Each dyad participated in a minimum of five intervention sessions.

Generalization

Generalization probes were conducted to determine whether the skills would generalize to a new communication partner. Two generalization probes were conducted during baseline and two during intervention with the participant with ASD and a different peer partner (i.e., a peer from a different dyad) who was at the same phase of intervention (i.e., baseline, intervention). Generalization probes followed the same procedures described for baseline and intervention sessions.

Maintenance

Maintenance probes were completed at 2 and 4 weeks after the end of the intervention phase. These probes followed the same procedures as the intervention probes. In order to control the amount of exposure to the video VSD app, the individuals did not have access to the app after the final intervention probe or between sessions.

Procedural Fidelity

To assess procedural fidelity, a trained graduate student in communication sciences and disorders (Graduate Student 1) watched videos of (a) the probe sessions, and (b) the video training session (i.e., viewing of the instructional videos), and compared the interventionist's behaviors to procedural checklists. Procedural fidelity was measured on a minimum of 30% of randomly selected probes for each of the four dyads in each of the three phases, as well as generalization and the training session video for each dyad (Kazdin, 2013). The student was trained in the procedural fidelity procedures by scoring randomly selected videos against the procedural standards (i.e., checklist) with the interventionist. When agreement exceeded 90%, the student scored 30% of a new sample of randomly selected videos independently. Procedural fidelity was calculated with the following formula: number of steps implemented correctly divided by the total number of steps implemented correctly plus steps omitted plus steps implemented incorrectly. The average procedural fidelity for probe sessions was 100% for baseline, 97.5% for intervention (range: 90%–100%), 95% for generalization sessions (range: 90%–100%), and 90% for maintenance sessions (range: 90%–100%). Procedural fidelity for instructional sessions was 100% for each training to each dyad.

Data Collection and Analysis

All probe sessions with the dyads were video-recorded by the interventionist for data collection purposes. The videos were then viewed in order to code the dependent and collateral variables.

Dependent and Collateral Variables

The primary dependent variable in this study was the frequency of symbolic communicative turns expressed by the adolescent with ASD during a 10-min interaction with a peer. A behavior was considered a *symbolic communicative turn* (adapted from Caron et al., 2021) if (a) the individual produced words (either spoken or through speech output from the AAC app), conventional signs, or conventional gestures (e.g., nodding head for "yes"); and (b) the individual was oriented toward the partner or an object of joint attention (as demonstrated by body orientation to the partner or shared activity; i.e., tablet). A turn was judged to have begun when an individual communicated (either via speech, sign/gesture, or activation of a hotspot on the VSD), and was judged to have ended when either the partner began a turn or 2 s passed without communication. We also collected data on two collateral variables. The first, the frequency of symbolic communicative turns expressed by the peer (using the same definition for symbolic communicative turn described earlier) was measured. A second collateral variable was the mode of communication (i.e., speech, AAC technology, sign/gesture, sign and speech, and speech and AAC technology) used by the participants with ASD. Speech was defined as the oral expression of language that included the natural production of intelligible words (Millar et al., 2006). Expression with AAC technology was coded when the individuals used their high-tech AAC devices or the video VSD application. Sign/gesture was coded when manual signs, approximations, or conventional gestures were used and the partner identified and said the meaning of the sign. Finally, if the individual communicated using a combination of modes within the same turn, this was coded as either speech and sign or speech and AAC technology.

Coding Dependent Variables

A trained graduate student in special education (Graduate Student 2) was trained (using videos from a previous study) until reliability in coding dependent and collateral variables was greater than 90% with the standard. Once training was complete, Graduate Student 2 acted as the primary coder for this study, and reviewed and coded the video recordings of all probe sessions. Graduate Student 2 was blind to the goals and conditions of the study and scored all data in a randomized order post hoc.

Interobserver Agreement

Graduate Student 1 was trained using videos from a previous study until reliability in coding dependent and collateral variables was greater than 90% with the interventionist. Graduate Student 1 then calculated interobserver agreement (independently from Graduate Student 2 after initial coding was complete) for no less than 30% of the probes for each phase of the study (i.e., baseline, intervention, and maintenance). Interobserver agreement was determined with point-by-point agreement. For a turn to be agreed upon, the time of the turn had to be within 1 s of the turn originally coded by the blind coder. Reliability was calculated by taking the number of agreements divided by the number of agreements plus disagreements plus omissions and multiplying by 100. Average baseline interobserver reliability for frequency of turns by the participants was 99% (range: 92%–100%); 93% for intervention (range: 91%–97%), 96% for generalization (range: 93%–98%), and for maintenance data, mean reliability was 94% (range: 92%–99%).

Data Analysis

To assess the impact of the intervention on the frequency of symbolic communication turns by adolescents with ASD during peer interactions, the interventionist graphed the frequency of communication turns for each participant and peer in each condition. The interventionist conducted a visual analysis of the data for changes in trend, slope, variability, immediacy of effect, and overlap to examine the effects of the video VSD app on symbolic communication turns (Kazdin, 2013). Additionally, effect sizes were calculated for each participant using Tau-*U* (Vannest et al., 2016). Tau-*U* is an effect size measure that calculates nonoverlapping data with baseline, controls for baseline trend, and has effect sizes that range from 0 to 1. Tau-*U* effect sizes are typically interpreted as small effect (< .65), medium to high effect (.66–.92), or strong effect (.93–1; Vannest & Ninci, 2015).

Social Validity

The social validity of the goals, methods, and outcomes (Schlosser, 1999) was assessed with both the direct (i.e., adolescents with ASD, peers) and indirect stakeholders (i.e., teachers, school SLP) of the intervention. Social validity for the participants with ASD was assessed via a Talking Mats procedure (Murphy et al., 2010). In the Talking Mats procedure, the participant was given photographs representing familiar activities, events, or items and asked to sort the items into three areas labeled with symbols representing “like,” “not sure,” and “don’t like.” The participants’ teachers provided examples of known likes and dislikes in order to confirm that the participants were making appropriate use of the Talking Mats technique. Each participant placed known dislikes (e.g., spiders, loud noises, vegetables) into the “dislike” category and placed known likes (e.g., trampoline, music, soda) into the “like” category. Two pictures representing the study and intervention were included in the selection process (i.e., picture of the participant and their peer partner with the tablet, and a picture of the tablet showing a VSD on the screen).

Social validity for peers, teachers, and an SLP was assessed using social validity questionnaires. At both baseline and following intervention, peers completed a five-item social validity questionnaire addressing the importance and effectiveness of their communication with their buddy. Following the intervention, the peer partners also completed an additional 16-item social validity questionnaire. The participants’ teachers (i.e., three teachers) and SLP (i.e., one SLP who worked with every participant) completed a 16-item social validity questionnaire after viewing a minimum of one pre-intervention video and one post-intervention video for their student(s), chosen at random from all probe videos.

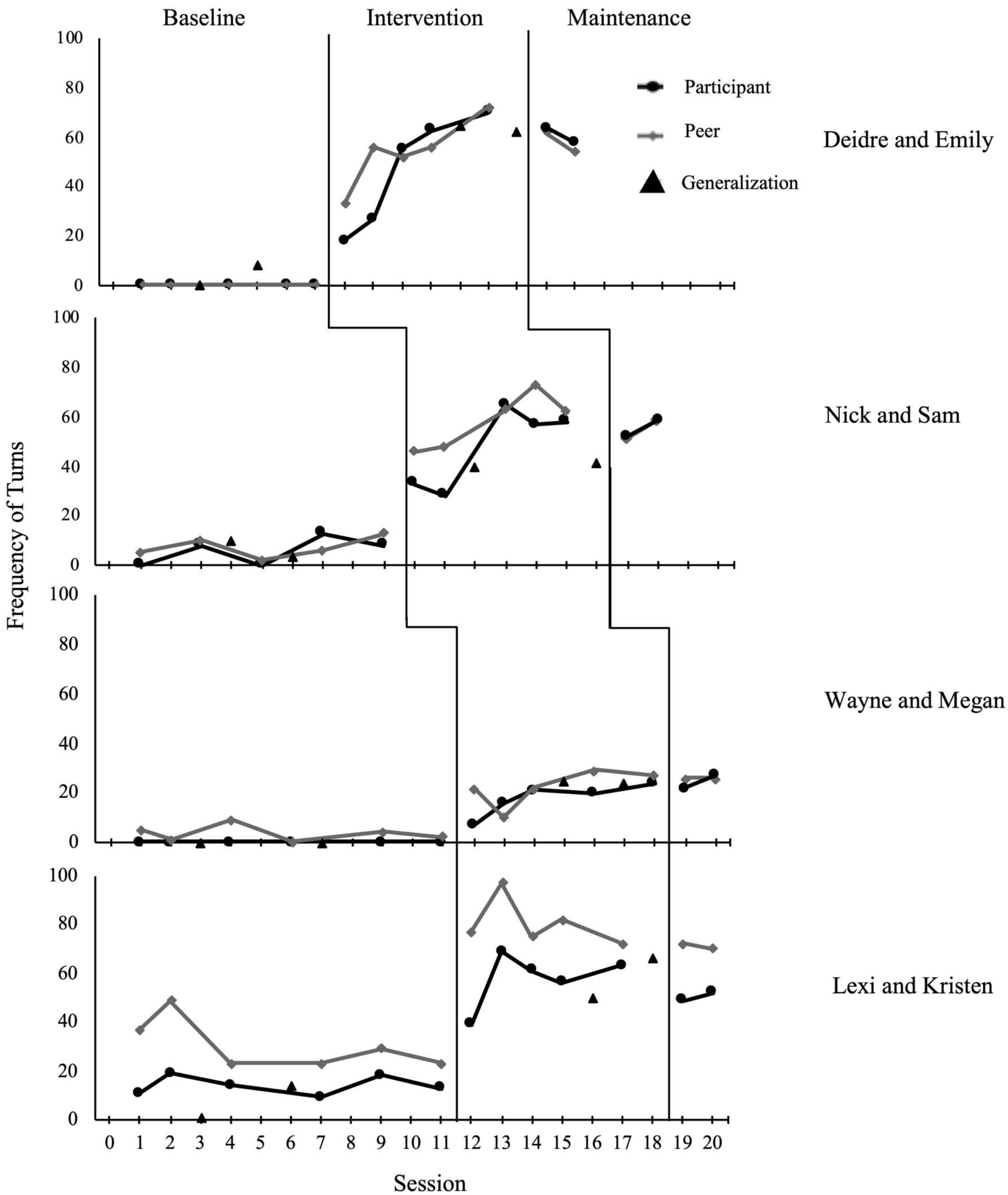
Results

This study investigated the impact of a video VSD intervention on the frequency of communicative turns by adolescents with ASD and complex communication needs as well as typical peers during social interactions. Additionally, the study measured social validity in regards to the effectiveness of the intervention with key stakeholders. Increases from baseline to intervention were observed for all four participants, with each demonstrating an increase in the number of communication turns following the introduction of the video VSD app (see Figure 2). The four typically developing peer partners also increased the frequency of their symbolic communicative turns following the introduction of the app. The results provide evidence that the use of video VSDs (a) supported the participants in social interactions during shared interest video viewing, (b) provided the participants with access to effective communication supports, and (c) required only minimal instructional via video modeling support (approximately 4 min) to teach participants to use the app to support their interactions.

Frequency of Symbolic Communicative Turns by Participants With ASD

All four participants took significantly more turns in intervention probes than in baseline probes. For each participant, interaction at baseline was minimal (if interaction occurred at all). Deidre increased from 0 turns during all

Figure 2. Frequency of communicative turns taken by participants with autism spectrum disorder (ASD) during interactions with peer partners, by peer partners, and by participants with ASD during interactions with generalization partners, in 10-min interactions during baseline, intervention, and maintenance.



sessions at baseline, to an average of 47 (range: 18–70) during the probes at intervention. Nick increased from an average of 6 turns (range: 0–12) during baseline, to an average of 48 (range: 28–65) during the probes at intervention. Wayne took 0 turns in all sessions during baseline and increased to an average of 17 turns during intervention (range: 7–24). Lexi had an average of 14 turns (range: 9–18) during baseline and increased to a mean of 58 turns (range: 39–69) during intervention (see Table 2).

There was evidence of an immediate increase in the number of communicative turns with continued gains over sessions during intervention for each of the four participants. There was no overlap for any participants between baseline and intervention phases. Data in the intervention

Table 2. Average number of communication turns, and use of communication modes, during baseline and intervention.

	Deidre		Nick		Wayne		Lexi	
Mode of communication	Baseline	Intervention	Baseline	Intervention	Baseline	Intervention	Baseline	Intervention
Speech	0	27	9	32	0	0	13	31
Sign/gesture	0	2	0	0	0	0	0	0
Speech and sign/gesture	0	2	0	0	0	0	0	0
AAC technology	0	15	0	16	0	18	0	27
Total	0	46	9	48	0	18	13	58

Note. AAC = augmentative and alternative communication.

phase had an increasing trend for each participant, with some variability between intervention sessions, suggesting learning that occurred overtime. Furthermore, all four participants continued to maintain their higher than baseline levels of communication at both 2- and 4-week maintenance probes. For each participant with ASD, an increase in the frequency of communicative turns was also observed during the generalization probes (i.e., during interactions with a different peer partner). During generalization, Deidre increased from a mean of 3 turns at baseline to 63.5 turns at intervention, Nick from 6.5 turns to 40.5, Wayne from 0 turns to 24.5, and Lexi from 7.5 turns to 58 turns at intervention.

Effect size, calculated using Tau-*U*, indicated strong effects for the video VSD intervention for all four participants with ASD (Vannest & Ninci, 2015). The Tau-*U* effect size for communicative turns for each participant was 1.0. Each participant had a weighted Tau-*U* score of 1.0, $p = .000$ with a 95% CI [0.56, 1.0] indicating a very large effect.

Communication Modes

Each symbolic turn was coded for the mode in which it was communicated, and all participants demonstrated both an increase in the number of different modes used, as well as an increase in the number of turns taken using each of the modes in their repertoire (see Table 2). All participants that used speech in baseline demonstrated increased use of speech in intervention (i.e., an increase in symbolic turns using speech). The participant that did not communicate using speech symbolically in baseline (Wayne), also did not use speech during intervention, but did demonstrate increases in symbolic turns with the support of the video VSDs in intervention. In fact, every participant demonstrated an increase in turns using the AAC technology during intervention. Small changes were observed for one participant (Deidre) in the use of signs and gestures, and signs and gestures used in combination with speech. No participants made combined use of speech and the video VSD within a single communicative turn.

Frequency of Communicative Turns by Peers

The frequency of communicative turns for all four peer partners also increased between baseline and intervention. Similar to the participants with ASD, the peers also demonstrated very low levels of participation at baseline, with sharp increases immediately following intervention. Emily (Deidre's peer), increased her frequency of turns from a mean of 0 turns (range: 0) in baseline to an average of 54 (range: 33–72) in intervention. Sam (Nick's peer), averaged a frequency of 7 turns (range: 2–13) in baseline and increased to 58 (range: 46–73) in intervention. Megan (Wayne's peer), averaged 4 turns (range: 0–9) at baseline and increased to an average of 22 (range: 10–29) turns during intervention. Lastly, Kristen (Lexi's peer), increased frequency of turns from an average of 27 (range: 23–49) during baseline to 81 (range: 72–97) during intervention.

At least some of these turns involved the addition of new vocabulary, including discussion of whether to create a hotspot, and the identification of vocabulary that would be programmed for the hotspot location for all participants. All four dyads added large numbers ($M = 11$; range: 5–27) of hotspots in their first three intervention sessions. Three of the four dyads (Deidre and Emily; Nick and Sam; and Wayne and Megan) then slowed their rate of addition ($M = 3$; range: 0–5), primarily making use of existing hotspots for their interaction. It should be noted, however, that these three dyads did continue to add some new hotspots during every intervention session (except for Session 5 for Nick and Sam). Lexi and her peer Kristen maintained a high rate of hotspot addition throughout all five intervention sessions ($M = 19$; range: 13–27). Additional details regarding the programming of hotspots during intervention, including additional discussion of the rate of vocabulary expansion, and the types of word programmed, are provided in Babb et al. (2021).

Social Validity

Following the intervention, all participants with ASD provided information on the perceived impact of the intervention. Using the Talking Mats procedure, all participants placed the two photographs of the intervention (as described above) in the "like" category rather than "don't like" or "not sure." For the peer partners, during baseline, the average rating for peers on their effectiveness of communication with the partner with ASD was 1.8 (range: 1–2; on a 5-point scale, where 1 = *strongly disagree* and 5 = *strongly agree*). Each peer also rated the communication effectiveness of their partner with ASD with the mean rating of

1.5 (range: 1–2). After intervention, peer rated their communication effectiveness with their partner as a mean of 4.8 (range: 4–5) and their partner's communication effectiveness as a mean of 4.3 (range: 4–5). On the additional social validity questionnaire, each peer rated the intervention positively (e.g., My buddy and I communicated more after the training) with an average score of 4.8 (range: 4–5). Furthermore, each peer indicated that they enjoyed and learned from the video training (M = 4.8; range: 4–5), and that the use of the app improved their communication as well as their partner's communication (M = 5). All four partners also strongly agreed with the statement "I would participate in this activity in the future." Responses to the open-ended questions on the benefits of the intervention focused on the usefulness of the app for supporting interaction (see Supplemental Material S1). An example is, "It inspired conversation that wouldn't have happened otherwise; we were able to communicate together—before this, we didn't talk" (Megan). Only one peer described a specific challenge in response to a question about the challenges of using the app—a peer stated that "when [her buddy] wasn't feeling well, it was harder to get him to participate."

After viewing randomly selected pre/post videos, each of the four staff members (blind to the conditions of the study) strongly agreed that having a way to communicate and interact with peers is an important goal (M = 5), that the activity was age-appropriate for their student as well as the peer (M = 5), and that the intervention was effective, efficient, and appropriate to support communication (M = 4.8; range: 4–5). In response to the open-ended questions about the benefits, the staff members stated they believed the participants enjoyed the activity, that they would implement the intervention with others in the future, and that they wished to continue the activity after the conclusion of the study. As stated by one teacher, "I felt like it brought the students together in a way that they could communicate without it feeling forced. The videos took a lot of the awkwardness out of the interaction and it really ended up being two friends spending time together." In response to open-ended questions about concerns, two teachers identified no concerns, and one teacher and one SLP expressed interest in how the interactions could be continued after the study ended. See Supplemental Material S1 for raw data and the responses to the 16-item questionnaire.

Following the conclusion of the study, all three teachers and the SLP expressed interest in continuing the intervention. The interventionist met with staff members (e.g., teachers, the SLP, and paraprofessionals) to provide training in the use of a commercially available video VSD app, Go Visual[3], and identified strategies for implementation in the future with additional peer partners across various settings. Additionally, at the end of the study, the app and commercially available options (e.g., GoVisual[3] by Attainment) were discussed with the participants' school teams and families. A 2-day in-service training in the use of the technology was also provided by the research team for the participants' teachers, SLPs, and paraprofessionals.

Discussion

Social interaction with peers is essential to the quality of life for all individuals. Although much of the research to date has focused on the role of the SLP in supporting social interaction with young children with ASD (Thiemann-Bourque et al., 2016, 2017), adolescents with ASD and complex communication needs face special communication challenges, and may require innovative approaches (Ganz et al., 2012; M. M. Smith, 2015). The results of this study provide evidence that a video VSD approach may be of assistance in addressing three key challenges for adolescents with ASD and complex communication needs: discussion around a shared topic of interest (Bagwell & Schmidt, 2011), access to specialized vocabulary pertaining to specific interests (M. M. Smith, 2015), and a shared conversational responsibility among the communication partners (Turkstra et al., 2003). The introduction of a video VSD app (with a brief video training) resulted in an increase in the number of communicative turns taken by adolescents with ASD and complex communication needs during interactions with peer partners. In addition, the intervention was viewed as an appropriate support to social interaction by adolescents with ASD, their typically developing peers, and teachers and SLP. Four factors may have contributed to the success of the video VSD intervention, and are discussed next.

Establishing and Maintaining a Shared Topic of Interest

Many adolescents with ASD experience difficulty in discussing past and future events (Favot, et al., 2019). Caron et al. (2018) suggested that these individuals may lack a strong symbolic schema of events, people, and items that are outside the here and now. The videos in the video VSD app provided the participants with a concrete shared context (Siegel & Cress, 2002) to support their interaction, and reduce the linguistic and cognitive demands of the activity.

Additionally, although adolescents with ASD may present with a restricted range of interests (American Psychiatric Association, 2013), the inclusion of these interests within intervention supports positive outcomes in social skills interventions (Ninci et al., 2018). In past social skills interventions with adolescents with ASD, there have been reports of both participants with ASD (e.g., Stauch et al., 2018), as well as their peers (e.g., Schmidt & Stitcher, 2012), losing interest in the intervention and declining further involvement. The use of videos on preferred topics (identified from the interests of participants and peers) may have contributed to the positive response to this intervention, both in the moment and across the duration of the intervention. All participants with ASD and all peers reported that they enjoyed the intervention, and all peers (in response to a

[3]GoVisual is an AAC application created by Attainment Company https://www.attainmentcompany.com/govisual

question asked as part of the social validity procedures) stated that they would participate in the intervention again.

Using Appropriate Vocabulary

Adolescents with ASD and complex communication needs are typically not included in social skills interventions (Babb, Raulston, et al., 2020), despite the fact that approximately 30% of individuals with ASD will not acquire the use of speech and require AAC supports throughout their lives (Tager-Flusberg & Kasari, 2013). The provision of AAC can assist individuals with ASD in communicating more successfully; however, AAC is sometimes withheld in the mistaken belief that it will suppress use of natural speech (Romski & Sevik, 2005). As in past research, this study provides additional evidence that AAC does not hinder the use of speech (Millar et al., 2006). For those individuals who demonstrated at least some speech in baseline (Nick, Lexi), and even for one individual who did not make use of speech in baseline (Deidre), the introduction of the video VSD app resulted in strong increases in speech during intervention, maintenance, and generalization.

There are a number of possible reasons why the use of the video VSD intervention may have resulted in increased use of vocabulary, not only with speech but with other modes as well, for all participants in the study. First, the videos may have provided contextual support for the interaction—for those individuals struggling with displaced talk, the videos assisted them in establishing a clear topic (Caron et al., 2018). Second, the hotspots in the video VSDs provided clear examples of appropriate vocabulary that may have served as models for the use of speech—at least some of the speech turns taken by the participants were imitations of the speech output of the device. Third, the hotspots provided a natural prompt (the video automatically pauses and the hotspot temporarily appears on the screen) to use the vocabulary at the appropriate time.

Participating in Social Interactions

It is interesting to note that although all four of the peers were competent speakers, and three of the four participants with ASD made use of speech as their primary method of communication, few turns were taken by either member of the dyad at baseline. There are a number of possible explanations for the limited interaction observed at baseline, and the increases following intervention. Although directed to "…Watch and talk about videos together," it is possible that both the peers (and the participants with ASD) were unsure of how to interact during a video watching activity and perceived the task expectation to be one of "viewing videos together" rather than talking about the videos together. Both participants and peers, however, demonstrated dramatic increases in the number of turns taken following the introduction of the video VSD and the brief training. This finding suggests that a combination of factors including (a) access to preferred videos providing a context for the interaction, (b) the provision of AAC (the video VSDs with hotspots), and (c) video training with models of individuals with disabilities and peers may have played an important role in the increase of communication turns. Alternatively, the intervention may have simply changed the peers' task expectations rather than actually teaching new skills. As highlighted in past reviews of partner training, it is possible that training for both the individual with complex communication needs, and their partners, is critical for successful AAC intervention (Kent-Walsh et al., 2015).

In addition, the pausing provided in the video VSD app may have provided a useful structure for the interaction. Individuals with ASD often play a responsive role within interactions and have been described as passive communicators (Paul et al., 2009). One possible reason for the increases observed in this study may be that the hotspots both marked a clear cue for taking a turn (the video automatically pauses and the hotspot temporarily appears on the screen), and provided needed communication supports for the participant with ASD at this time (Babb et al., 2019). In a video VSD approach, the needed vocabulary is embedded within the activity (i.e., the video), providing immediate access to relevant vocabulary, and eliminating the need for individuals to shift their attention between their AAC system, the activity at hand, and their communication partner (M. M. Smith, 2015). Finally, the opportunity to easily add vocabulary during an ongoing activity may have contributed to the increase in communication turns observed for all participants. The activity of adding vocabulary *just-in-time* provided something for the dyad to do together, rather than passively watching the videos (Schlosser et al., 2016). This activity may have played a role in the results by providing the participants something to do together, as well as something to talk about.

Minimizing Complexity in Social Interaction Interventions

Social interaction interventions require training both for the individual with a disability and the communication partner (Kasari & Smith, 2013; Watkins et al., 2015). Particularly in the case of interventions with adolescents, however, it is important to minimize the complexity of interventions and reduce the role of adults so as to maintain the authenticity of the interaction (Rubin et al., 2011). There are at least three possible reasons why this intervention resulted in meaningful changes in peer interaction following the introduction of the video VSD app, and with less than 4 min of training. One possible explanation is that the video VSD app was easy to use. Adding hotspots required only a small number of steps, and the pausing of the video when hotspots appeared during the interaction served as natural cues for interaction. Another possible explanation is that the intervention made use of an existing activity (i.e., watching preferred videos) that not only made use of key interests of both the individual with ASD and the partner (Ninci et al., 2018), but is also a common shared activity for adolescents. Finally, the video training, although brief, appeared to be effective in providing models of appropriate interaction for all four dyads.

The introduction of a five-step strategy and multiple models of expected use, as portrayed in a short (less than 4 min) video may have contributed to the changes in interaction behavior for both the participants with ASD and the peers.

Limitations and Future Research

This study provides initial evidence that a video VSD approach may have a positive impact on communication for adolescents with ASD and complex communication needs during social interaction with peers. There are limitations to consider, however, when interpreting the results. First, the population of individuals with ASD is heterogeneous, and this study included a small sample size (n = 4). The small sample size limits the generalizability of the results, and future research should investigate a larger number of individuals with varying communication skills and learning abilities. Second, generalization was only assessed with one additional partner (a peer who had also watched the instructional video and was a part of the study) and did not assess generalization across different settings, to untrained peers, or other activities such as using the hotspots during a recreational or functional activity (e.g., capturing videos and programming hotspots while making a pizza with a friend). These data are important to determine the value of the intervention within the real world. Third, when peer interaction interventions include training for a peer, one concern is that individuals with ASD will always require access to trained peers in order to communicate successfully. Although each dyad was trained separately in this study, it is possible that the intervention could be taught to an entire class or group. Future research should investigate the impact of the intervention as a classroom or grade wide implementation. Finally, the brief training may have provided important models of expected participation for both the participant and the peer, so that following the training the participant made increased use of existing modes of communication (e.g., speech and sign). Additional research is needed to analyze the training and assess which components were most effective.

Conclusions

Social interaction is often difficult for individuals with ASD, and can be particularly challenging for adolescents with ASD and complex communication needs. This study adds to the growing body of research that has demonstrated positive communication gains for individuals with ASD and complex communication needs when provided with video VSD supports designed to maximize communication and participation in important activities of daily life (e.g., Babb et al., 2019; Babb, McNaughton et al., 2020; Caron et al., 2021). The findings of this study provide evidence that a video VSD intervention can increase the number of communication turns taken by individuals with ASD and complex communication needs during social interactions with peers without disabilities. Perhaps most importantly, however, the resulting social interactions were valued by the adolescents with ASD, their peer partners, and the educational staff at the school. The potential positive impact of appropriate communication supports for adolescents with ASD and complex communication needs was clearly illustrated in a quote from one of the peer partners: "I was going to ask for a new buddy at the end of this year. I was going to ask for a buddy that could talk, but after this, I am not. I have learned how to talk with my buddy, and she has learned how to talk with me."

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