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Enhancing Independent Participation Within Vocational Activities for an Adolescent With ASD Using AAC Video Visual Scene Displays

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Abstract

Adolescents with autism spectrum disorder (ASD) often require support both for learning new skills and for communication. This study used a multiple baseline across activities design to evaluate the effect of videos with integrated visual scene displays (video VSDs), presented using a tablet-based app, on the percentage of steps completed independently within vocational training tasks by an adolescent with ASD and complex communication needs (CCN). Using the video VSDs, the participant met the mastery criterion for completing three tasks (including participation in communication exchanges) in a vocational setting. The results provide evidence that video VSDs may provide an effective support both for learning new skills in vocational contexts, and as a method of augmentative and alternative communication for individuals with ASD and CCN.

Keywords

ASD, augmentative and alternative communication, AAC, visual scene display, video prompting, vocational tasks

Although over 70% of adults in the United States have jobs (Organisation for Economic Co-operation and Development, 2018), only 25–50% of adults with autism spectrum disorders (ASDs) are employed (Hendricks, 2010; Wehman et al., 2014). Many of the individuals with ASD who are employed present with relatively mild forms of ASD, use speech to communicate, and have workplace literacy skills (Howlin, Alcock, & Burkin, 2005; Howlin & Moss, 2012; Wehman et al., 2014). The outcomes for individuals who present with more severe forms of ASD, do not make use of speech, and do not have workplace literacy skills, are markedly worse (Nicholas, Addridge, Zwaigenbaum, & Clark, 2015; Shattuck et al., 2012), with less than 14% employed (Nord, Stancliffe, Nye-Lengerman, & Hewitt, 2016).

Characteristics typically associated with ASD, such as difficulties in learning new skills (e.g., following spoken directions) and working independently (e.g., completing tasks without prompting), can make it difficult for individuals with ASD to participate in the educational and workplace training activities needed to obtain employment (Hendricks, 2010). Support from educational staff is often used to provide an individual with ASD with cues and prompts to complete workplace tasks (Macduff, Krantz, & McClannahan, 2001). However, research suggests that constant adult proximity can create prompt dependence and overreliance on support from others (Giangreco & Doyle, 2002).

In addition to the challenge of learning to perform new skills independently, persons with ASD often struggle with the communication skills (e.g., greeting customers, requesting assistance) that are identified by employers as key to success in the workplace (Bryen, Potts, & Carey, 2007; Higgins, Koch, Boughfman, & Vierstra, 2008). These communication challenges are frequently experienced by 20–30% of individuals with ASD who do not develop functional speech to communicate and who are described as having *complex communication needs* (CCN; Wodka, Mathy, & Kalb, 2013). Unless appropriate communication supports are provided, limited speech can be a severe barrier to communication and participation, especially within vocational settings. It has been estimated that the employment rates for individuals with CCN are even lower (less than 5%) than those for individuals with ASD (Light & McNaughton, 2015; McNaughton & Bryen, 2002). The use of *augmentative and alternative communication* (AAC), such as sign language, picture communication boards, and AAC apps on mobile technology, has been demonstrated to benefit persons with ASD (Foley & Staples, 2003; Ganz, Boles, Goodwyn, & Flores, 2014; Sigafoos et al., 2004); however,

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there is only a limited understanding of how AAC might be used to support persons with ASD and CCN in participating in the workplace (Richardson, McCoy, & McNaughton, 2019).

In recent years, a variety of strategies have been investigated to facilitate successful transition into employment for persons with ASD and CCN (Pillay & Brownlow, 2017). In a *video modeling* approach, a video is created of an individual performing a target skill—the learner then watches the video and imitates the skill observed in the video. Video modeling has been described as an effective intervention to support individuals with ASD in performing targeted vocational, independent living, and community skills (e.g., Goodson, Sigafoos, O'Reilly, Cannella, & Lancioni, 2007; Spriggs, Knight, & Sherrow, 2015). *Video prompting* has been suggested as a modified video modeling approach: A chained task is broken into smaller, more manageable steps using task analysis (Cooper, Heron, & Heward, 2007); the individual watches each step of the task, performs that step, and then moves on to the next step (Bereznak, Ayres, Mechling, & Alexander, 2012; Sigafoos et al., 2005). For individuals with ASD, video prompting has been demonstrated to be successful in supporting acquisition of workplace and independent living skills (Cannella-Malone et al., 2011; Domire & Wolfe, 2014; Sigafoos et al., 2007). Video prompting may be a particularly useful approach for individuals with ASD who are at risk for prompt dependency, as minimal adult instruction and prompting is required to teach the skills (Bellini & Akullian, 2007; Hume, Loftin, & Lantz, 2009).

While the use of video prompts can assist persons with ASD in learning the steps in a task, additional strategies are needed to support the communication of persons with ASD who have CCN. AAC systems have been demonstrated to be useful in a variety of vocational settings for persons with CCN (Bryen et al., 2007; Richardson et al., 2019). However, persons with ASD who also have CCN may require technology supports both for learning the steps in a task (e.g., video models) and for communicating in the workplace (e.g., an AAC system). Given their need for supports to address two different challenges, it may be difficult for individuals with ASD and their communication partners to make coordinated use of two devices or two apps while participating in vocational settings (Richardson et al., 2019).

Video Visual Scene Displays

In order to address the dual challenge of supporting both the learning of new skills and communication, Light, McNaughton, Jakobs, and Hershberger (2014) have suggested the use of videos with integrated visual scene displays (video VSDs). A visual scene display (VSD) is an image (e.g., photograph) of a meaningful event within the life of the individual with CCN which has been programmed with relevant vocabulary using "hot spots" within the scene. When selected, the hot spot produces recorded speech output of a word or phrase. For example, an adolescent or adult with ASD and CCN entering a job site might have a VSD of themselves and their supervisor at the work setting. By activating the programmed hot spot that produces the phrase "Hi, I'm ready to work," the individual could greet their supervisor and let them know they are ready to start the vocational activity.

There are a number of AAC apps (e.g., GoTalk NOW[1] and SnapScene[2]) that utilize VSDs with still images (e.g., photographs). VSDs provide a means to capture images of actual events experienced by the individual and present language concepts within those familiar events (Light & McNaughton, 2012). Recent research with children, adolescents, and young adults with CCN provides evidence of increases in the frequency of communication turns taken by those individuals following the introduction of apps with VSD technology (Drager et al., 2017; Holyfield, Caron, Drager, & Light, 2018).

Because videos capture dynamic routines to a greater degree than static photos, it was hypothesized that videos with integrated VSDs might better facilitate participation and communication within daily activities. Video VSDs are videos that capture dynamic life events that can be paused at key junctures in the event to create a VSD with programmed hot spots of relevant vocabulary concepts (see https://tinyurl.com/rerc-on-aac-vVSD, for an example of video VSDs). Light et al. (2014) suggested that video VSDs would capitalize on the strength of VSDs but increase effectiveness by incorporating the dynamic movement found in real-world communication and interactions. Additionally, as the video automatically pauses at key points in the activity, the individual who uses AAC is cued to the opportunity for communication and participation, with the VSD providing the appropriate vocabulary.

O'Neill, Light, and McNaughton (2017) conducted a pilot case study (using a nonexperimental design) to investigate the use of video VSDs with an adolescent with ASD. The researchers provided the participant with video VSDs in three activities (i.e., paper shredding, riding the bus, and making dye cuts). Results indicated changes in performance immediately after introducing the video VSDs, and the participant needed only a small number of intervention sessions to learn to complete several community and vocational tasks independently.

In summary, video VSDS may provide a useful approach to addressing a current area of identified need: integrated technology support for both communication and participation in employment settings for persons with ASD and CCN (Light, McNaughton, & Caron, 2018; Richardson et al., 2019). Although the O'Neill et al. (2017) case study provided preliminary evidence of the usefulness of video VSDs for an adolescent with ASD, there is a clear need for experimentally controlled research with persons with ASD and CCN. The purpose of the current study was to investigate the effect of a video VSD application on the percentage of steps (including communication opportunities) completed independently by an adolescent with ASD and CCN during vocational activities.

Method

Research Design

This research study made use of a single-case multiple baseline across activities experimental design (Kazdin, 2013) to evaluate the effects of video VSDs on the completion of the steps in four vocational activities. In this design, the researcher measures a target behavior for an individual across multiple activities. When a stable baseline is observed for the first activity, the independent variable is applied to that activity while the other activities remain in baseline. When criterion is met for the first activity, the independent variable is applied to the next activity and the sequence continues until the independent variable has been applied to all activities (Cooper et al., 2007). The design was utilized to show the behaviors altered upon implementation of the intervention, effectively showing the relation between the intervention and the targeted skill (Kazdin, 2013). The study involved four phases: baseline, intervention, maintenance, and generalization.

Independent Variable

The independent variable was the video VSD app (i.e., videos with integrated VSDs and embedded hot spots). In addition, the researcher (the first author) provided brief instructional sessions, approximately 5 min in length, which included both a model and guided practice in the use of the app to complete the three intervention activities. One task was used to investigate generalization; in this condition, the researcher placed the tablet with the app in proximity to the participant but did not provide instruction.

Dependent Variable

The dependent variable was the percentage of steps completed independently in each task, including both motor and communication acts as identified in the task analysis. For example, the task analysis for "putting away books" included 11 steps, 4 of which were communication acts. Independent completion of a task step was operationally defined as completing the step within 5 s of the naturally occurring environmental stimulus. An incomplete step was defined as completing a step out of sequence, completing a step incorrectly, or failing to initiate the task within 5 s. For the steps that involved communication opportunities, the step could be completed by touching the tablet to activate the hot spot. The dependent variable was calculated by dividing the number of steps completed independently by the total number of steps and multiplying by 100.

Participant

Individuals were eligible for inclusion if they met all of the following criteria: (a) were diagnosed with ASD, (b) were aged between 13 and 21, (c) presented with speech that did not meet all of their daily communication needs, (d) experienced difficulty completing simple tasks without adult support, (e) lived in homes in which English was the first language, and (g) demonstrated unimpaired/corrected vision and motor skills and hearing within normal limits per individualized education plan or parental/teacher report. James, the participant selected for the study, met all inclusionary criteria.

The participant, James, was an 18-year-old male with a diagnosis of severe ASD based on the Childhood Autism Rating Scale 2 (Schopler, Bourgondien, Wellman, & Love, 2010). He attended a rural school district in the northeastern United States. James received his instruction in a self-contained special education classroom and attended one elective class (e.g., cooking) with his general education peers each semester. James demonstrated significant difficulties with receptive language: He received a standard score of 40 (below the 1st percentile) on the Peabody Picture Vocabulary Test–IV (Dunn & Dunn, 2007). He typically communicated through "yes/no" responses (e.g., signaling "yes" with a thumbs up gesture) to simple spoken questions from communication partners (e.g., "Do you want pizza?"). He also pointed to items in the environment on request and to communicate choices among preferred items. Prior to the study, he did not use any form of assistive technology to support communication.

James typically required multiple prompts (e.g., repeating the question or direction) in order to respond to simple one-step instructions (e.g., "Stack the books") or questions ("Do you want ice cream?"), and he was less likely to respond to unfamiliar partners. He also required multiple prompts (e.g., repetition of oral instructions, modeling of expected behavior, physical guidance) in order to complete basic tasks and skills outside of his normal routine.

James' hearing, vision, and motor skills were reported to be within normal limits by a parent and his speech language pathologist. James was recommended for this study by his teacher and transition coordinator based on his dependence on prompts to complete tasks within the community. Both the Human Research Ethics Committee at the researcher's university and the participating school district provided approval for the study. James' family provided consent for his participation in the research project.

Setting and Tasks

The study took place in a rural elementary school library. James was scheduled to work in the library for approximately an hour and a half one afternoon a week as part of his prevocational transition plan. The targeted vocational tasks within the library were checking in books, putting books away, making dye cut prints, and paper shredding. The library was an unfamiliar work placement for James at the start of the study procedures. A paraprofessional attended each work session with James as a one-to-one support but did not participate in the study.

Each of the four targeted vocational tasks occurred in the library and was selected using the following criteria: (a) occurred within the vocational setting, (b) included a predictable series of steps, (c) included opportunities for communication, and (d) was not currently completed independently by James at baseline. Task analyses were completed for four tasks: Three tasks (i.e., checking in library books, putting library books away, and making dye cut prints) were targeted in

Table 1. Example of Task Analysis for Putting Library Books Away.

Step	Video Footage	Text on Screen	Hot Spot Location (Spoken Message)
1. **Ask to put the books away: "Can I put the books away?"[a]**	Model approaches staff member and asks to put the library books away	Ask a staff member to put the books away	Can I put the books away?
2. Pick up the box of books	Model walks to the box filled with returned library books and picks up the box	Pick up the box of books	
3. Bring the box to the table	Model carries the box of library books to the table near the bookshelves	Carry the box to the table	
4. Empty the books on to the table	Model takes out each library book from the box and puts them on the table	Empty the books on to the table	
5. Sort the books into piles based on categories	Model sorts each book into two separate piles on the table	Sort the books into piles based on categories	
6. **Ask a staff member to check your work: Can you check my work?**	Model turns and asks staff member to check completed work	Ask a staff member to check your work	Can you check my work?"
7. **Tell a staff member you are going to put the books away: "I'm going to put the books on the shelf"**	Model informs staff member that the books are going to be put back on the shelf	Tell a staff member you are going to put the books away	I'm going to put the books on the shelf."
8. Pick up the books and take them to the bookshelves	Model picks up the piles of books and carries them to the bookshelf	Carry the books to the bookshelf	
9. Put the books in the correct place on the shelf	Model puts the first pile of books on the top shelf behind the bookend and the second pile of books on the second shelf behind the bookend	Put the books on the bookshelf	
10. Return the box	Model walks back to the table, picks up the box, and returns the box	Return the box	
11. **Tell a staff member you are finished: "I am finished putting the books away"**	Model approaches staff member and informs that the task of putting books away is complete	Tell a staff member you are finished	I am finished putting the books away

[a]Steps that are in bold represent hot spots to fulfill communication opportunities.

intervention, one task (i.e., paper shredding) was used to assess generalization to new tasks without instruction.

To create the task analysis, the researcher first performed the task herself in order to identify the component steps and the most natural sequence of the steps (Snell & Brown, 2006). The researcher then performed the task several times to refine the steps and to ensure the order of the steps was the most efficient for the participant (Cooper et al., 2007). The tasks ranged in complexity from 11 to 16 steps. Each step included an action to be completed including motor and/or communication acts (see Table 1).

Materials

Tablet and video VSD app. The intervention used a 12-inch Samsung Galaxy Note Pro 7®[3] tablet. The tablet contained the EasyVSD (see Note 2) app, which was used to create the video VSDs used in this study. Figure 1 presents a screenshot of a VSD created in the EasyVSD app[4] for the task "Putting away library books." To create a video VSD, the researcher captured videos of the target task using the onboard camera. Next, the researcher paused the video at the end of each step in the task, automatically creating still VSDs at these junctures. Finally, the researcher programmed the VSDs with relevant vocabulary under hot spots in the VSD as required (see Table 1).

When the participant viewed the video VSD app, the selected video filled the majority of the screen of the tablet, and navigation icons and a play/pause button were positioned vertically on the left-hand side of the screen. For example, when James finished sorting the library books, he then watched the video model of the next step in the task (i.e., telling the staff that he is going to put the books away); the app automatically paused at the end of the video model of this step, providing a VSD with hot spots of relevant vocabulary to support his communication, in this case the phrase, "I am going to put the books away" (as illustrated in Figure 1).

The researcher taught James a five-step procedure to operate the video VSD app: (a) press the play button (the arrow located at the top left), (b) watch the video segment portraying the step in the task (shown in the large area on the right side of the screen), (c) perform the motor act to complete the step or fulfill the communication act depicted in the segment by selecting the hot spot from the VSD (i.e., selecting the hot spot or circle on the books on the shelf to retrieve the spoken message, "I am going to put the books away"), (d) press the play button again to watch the video model of the next step or select the thumbnail of the video of the next step from the left menu, and (e) repeat Steps (a)–(d) for each step to complete the entire task.

Figure 1. Screenshot of the EasyVSD app and intervention photo as viewed by participant. This screenshot shows the visual scene display seen by the participant during the "putting the books away" activity and includes an embedded hot spot ("I am going to put the books away").

Programming the video VSD app. The researcher programmed the video VSDs for each task prior to the intervention. As a first step in creating the video VSDs, separate videos of the researcher performing all needed steps in each task were recorded on the Samsung Galaxy Note Pro 7® (see Note 3). The researcher, a female graduate student, served as the model in the videos because the participant could not complete the targeted tasks independently at the beginning of the intervention. Videos were then transferred to an iMac computer and edited in iMovie[5] 10. 1. 2 software. The researcher edited the videos to create brief focused segments of video that corresponded to the steps identified within the task analyses for each task (Duker, Didden, & Sigafoos, 2004). A brief text statement describing the key behavior (e.g., "Open the drawer") was added to the bottom of each video. Each video was muted to eliminate additional background noise from the video recordings. The researcher then uploaded the videos to the video VSD app. Each video was approximately 10–15 s in length and portrayed one of the target steps within the task (see Table 1). Each task required a series of 7–12 motor acts as well as three to four communication acts. When the step required a communication act, the researcher added hot spots and embedded messages to the videos using the video VSD app by pausing the video at the opportunity for communication (thereby automatically creating a VSD), drawing hot spot(s) on the VSD, and recording relevant communication message(s). When viewed by the participant, the video paused automatically wherever a VSD had been created by the researcher. When a VSD appeared, the outline of the hot spot was displayed momentarily in order to mark a communication opportunity (see Figure 1).

Procedures

James participated in four different phases of intervention during this study: baseline, intervention, maintenance, and generalization (described in detail below). In all four phases, each session for a particular task began with a probe activity. A minimum of five baseline sessions were conducted separately for each task prior to intervention (Kratochwill et al., 2013). Once the participant demonstrated a stable baseline with the first task (i.e., a minimum of five data points if baseline was stable, additional data points if the baseline was not stable), the researcher introduced intervention for the task. The other tasks were held in baseline. Intervention sessions were conducted approximately once per week with sessions lasting 1–1.5 hr. Unfortunately, several sessions were cancelled over the course of the study due to weather closings at the school.

Intervention continued with the first task until the participant demonstrated an intervention effect. An intervention effect was judged to have occurred when the participant demonstrated an increase of at least 20% in the percentage of steps completed above the highest baseline probe (e.g., performance at 31% or higher, if the highest baseline probe was 10%) for three consecutive sessions. Once an intervention effect was observed for the first task, the researcher conducted baseline observations for all remaining tasks and introduced the intervention to the next task that demonstrated a stable baseline. The same approach was followed for the third task. Intervention continued with each task until the participant demonstrated mastery, defined as three consecutive probes with greater than 80% independent task completion. After mastery was observed for a task, the researcher introduced the maintenance phase for that task. During maintenance, the participant had access to the video VSD app, but no instruction was provided. In order to maintain experimental control, the participant only had access to the video VSD app during intervention and generalization sessions and maintenance probes. A trained graduate student video recorded all sessions (including all probe activities).

Probe procedures. During the probes, the researcher brought the student to the work setting (i.e., library). The researcher then provided an initial cue at the beginning of the task (e.g., "It's time to put the library books away") and waited 5 s. If the participant successfully completed the step in the task, the researcher then said, "What's next?" If, at any point, the participant did not initiate action within 5 s, completed the step incorrectly, or completed a step out of sequence, the researcher blocked the view of the participant, completed the targeted step, and said, "What's next?" (e.g., Bereznack et al., 2012; Sigafoos et al., 2005). No feedback was provided at any time during activities.

Baseline phase. During the baseline phase, only probe activities (described above) were conducted. James did not have access to the video VSD app (as was typical in his classroom program) and no instruction was provided during the baseline phase.

Intervention phase. Each session in the intervention phase included both a probe and an instructional activity. James had access to the video VSD app during both probe and instructional activities. The probe activities were identical to those used in baseline (as described above) except the tablet (with the video VSD app) was placed in close proximity to the participant at the beginning of the probe session. The probe activity always preceded the instructional session, which was provided immediately after the completion of the probe activity.

Instructional sessions. Instructional sessions included both a review of the video VSD app for a task (as depicted on the app) and guided practice in the use of the app to complete the task. During the review of the video VSD app, the researcher and the participant sat in a quiet area. At that time, the researcher directed the participant to attend while she navigated the tablet, playing each video, and activating each communication hot spot. After the researcher went through the task 1 time, the researcher encouraged the participant to hold the tablet, play each video, and activate each communication hot spot. Each time the video was played, the researcher read aloud the text at the bottom of the video.

Following the review of the video VSDs for the task, the researcher guided the participant in using the app to complete the task 2 times. During this guided practice, the researcher provided an initial cue (i.e., "It's time to _____") at the beginning of the task. Next, the researcher used the following least to most prompting hierarchy to ensure that the participant completed that task successfully: (a) time delay of 5 s, (b) gestural prompt, (c) oral prompt, and (d) physical prompt. If, at any point, the participant performed an error, the researcher interrupted the error and continued the prompt sequence. Each instructional session was approximately 5 min in length.

Maintenance phase. When the participant attained mastery in a task (defined as three consecutive probes with greater than 80% of the steps completed independently), the task entered the maintenance phase. During this phase, no instructional sessions were provided for a task—the participant simply participated in probes (with access to the tablet with video VSD) at 1, 3, and 5 weeks after mastery was first demonstrated. The participant did not have access to the video VSD app for this task in the time intervals between maintenance probes.

Because James demonstrated mastery for Tasks 1 and 2, maintenance data were collected for these tasks. Maintenance data for Task 3 were not collected due to the end of the school year. Procedures were available for booster instructional sessions if the participant demonstrated performance below 80% during any of the maintenance probes, however performance remained above 80% on all maintenance probes, so no booster sessions were needed.

Generalization. In order to assess generalization, the researcher collected data for the participant on a task (i.e., shredding paper) for which no instruction was provided. As with all tasks, the researcher collected five data points in the baseline phase for this task. In contrast to Tasks 1, 2, and 3, no review of the video VSD or guided practice was provided for the generalization task. During the probe in the generalization phase, the researcher gave the tablet with the video VSD app (programmed for the paper shredding task) to the participant and provided an initial cue (i.e., "It's time to shred paper"). The researcher did not provide specific directions to use the app nor did she demonstrate how to do so.

Procedural reliability. To assess procedural reliability, the researcher developed a checklist for the delivery of each phase of the study (baseline, intervention, maintenance, and generalization). A randomly selected sample of sessions, constituting a minimum of 20% of the sessions for each of the four tasks (Kazdin, 2013), as well as each of the four phases were evaluated against the procedural standards. Procedural integrity was calculated according to the following formula: number of steps correctly implemented divided by the total number of steps implemented correctly plus those omitted plus those implemented incorrectly. A graduate student was trained to score procedural reliability. Procedural reliability was 97% (range = 95–100%) for baseline, 98% (range = 91–100%) for intervention, 98% (range = 93–100%) for model sessions, 99% (range = 98–100%) for instruction sessions, 100% for maintenance, and 98% for generalization.

Data Collection and Analysis

In order to code the data, a trained graduate student reviewed and coded (post hoc) the video recordings of the probe activities. Then, the data were summarized for each probe and graphed separately for each task in the order in which they were collected. The data were analyzed visually for changes in trend, slope, and variability to examine the effects of the video VSD app on independent task completion (Kazdin, 2013).

Reliability. The researcher and a trained graduate student calculated interobserver agreement for a minimum of 20% of the sessions for each phase (i.e., baseline, intervention, maintenance, and generalization). Interobserver agreement was calculated by taking the number of agreements divided by the number of agreements plus disagreements plus omissions and multiplying by 100. Average baseline reliability was 96% (range = 91–100%); for intervention, maintenance, and generalization data, mean interobserver reliability was 100%.

Social Validity

The researcher developed a 13-item questionnaire (see Appendix Table A1) to assess the social validity of the intervention (Schlosser, 1999; Wolf, 1978). James's special education paraprofessional (who attended the library activity with him each week) provided oral responses to the questions, which were recorded and transcribed.

Results

The results (see Figure 2) provide evidence that using video VSDs supported James in learning to complete vocational tasks independently within a vocational setting and to communicate with others at these times. Changes in performance were observed immediately upon the introduction of the app with the participant. James required only a small number of intervention sessions to demonstrate a treatment effect and achieve mastery.

During baseline for Task 1 (checking in library books), James completed an average of 11% (8-16%) of the steps correctly. James increased to 42% correct after the first intervention session, and 100% after the second intervention session. For Task 2 (putting library books away), James averaged 5% (0–9%) of steps completed correctly during baseline and increased to 90% correct on each of the first three probes after intervention began. For Task 3 (making dye cut prints), James averaged 15% (0–21%) of steps completed correctly for the eight baseline sessions and then performed 50% of the steps correctly in the first intervention probe; in subsequent sessions, he performed with greater than 80% accuracy.

Mastery (defined as 80% or above on three consecutive probes) was achieved for Task 1 at the end of six intervention sessions, for Task 2 at the end of three intervention sessions, and for Task 3 at the end of four intervention sessions. Maintenance probes were conducted for Tasks 1 and 2, and task completion scores were 90% or higher for both tasks at 1, 3, 5 weeks after instructional sessions commenced.

Task 4, paper shredding, was used as a generalization activity. James had a mean performance of 9% of steps completed independently on the five baseline probes. In the generalization probe, James had access to the tablet with the app, but no modeling or instruction was provided. Again, due to the end of the school year, it was only possible to collect a single generalization probe, at which time James completed 63% of the steps correctly, a substantial increase from baseline.

James demonstrated low levels of performance with limited variability on Tasks 1–3 during baseline. Performance on Task 4 showed greater variability during baseline, but the last data point in baseline was a downward trend and overall performance was low (less than 25% of steps completed). James exhibited a significant change in performance from baseline to intervention, and the graphs for Tasks 1 and 2 display stable performance at high levels (over 90%). For Task 3, although the final data point represents a slight drop in performance, James was still above mastery criterion. Performance on Tasks 1 and 2 remained high in the maintenance phase.

Additionally, the researcher calculated an effect size for the intervention using Tau-*U* (Vannest, Parker, Gonen, & Adiguzel, 2016). Tau-*U* is a nonparametric effect size measure that calculates nonoverlapping data with baseline and controls for baseline trend (Rakap, 2015). The weighted Tau-*U* was 1.0, $p = .000$ with a 95% confidence interval [0.56, 1.0] indicating a large effect (Rakap, 2015).

Social validity results. In responding to the Social Validity Questionnaire, the paraprofessional reported that the intervention was socially appropriate, effective, and efficient in the setting and that the intervention was successful in increasing independence in both task acquisition and communication responses and initiations. The paraprofessional stated that she would like to use the technology again, would use it with other students, and would recommend it to other paraprofessionals to use with students (see Appendix Table A1 for complete questions and responses).

Discussion

In order to transition into adult roles in the community, adolescents with ASD require support in learning both vocational and communication skills (Holyfield, Drager, Kremkow, & Light, 2017; Nicholas et al., 2015). Past research has examined the use of video prompting during vocational activities for individuals with ASD (e.g., Bereznak et al., 2012; Van Laarhoven, Winiarski, Blood, & Chan, 2012); however, there is only limited research on the provision of communication supports at these times (McNaughton & Light, 2015). O'Neill et al (2017) provided preliminary evidence of the potential benefits of video VSDs for a young woman with ASD who used some speech to communicate and demonstrated functional literacy skills. The current study extends the findings from O'Neill et al. by providing empirical evidence of the benefits of video VSDs in supporting independent completion of vocational activities and communication for a young man with ASD, no speech, and no functional literacy skills.

The intervention using video VSDs was successful in teaching an adolescent with ASD to independently complete three work tasks by following a sequence of steps that included opportunities for communication. James reached mastery for

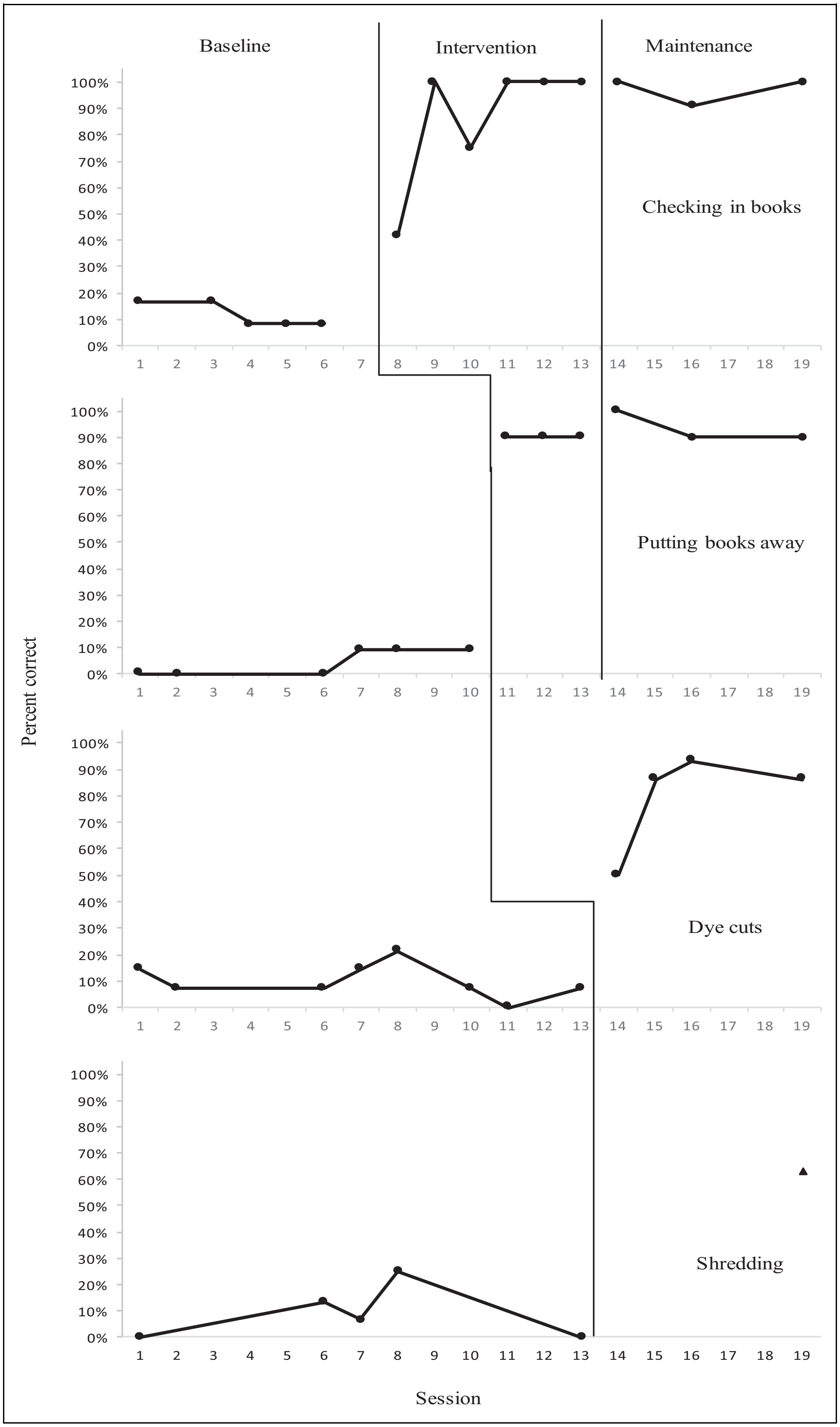

Figure 2. The percentage of steps completed independently by James during baseline, intervention, maintenance, and generalization across the tasks.

three tasks in a small number of intervention sessions. He used communication supports within the app to perform communication acts such as asking a supervisor to start a task, letting a supervisor know he was finished with a task, and requesting assistance while conducting tasks. The participant completed tasks independently with the video VSD application, therefore reducing the need for a job coach or paraprofessional. Additionally, the results from the generalization probe suggest that the participant may be able to use the app to learn new tasks independently without explicit instruction.

The rapid acquisition of both vocational and communication skills in such a short period of time provides evidence that integrated support for communication and task skills, as provided by video VSDs, is a promising approach to increasing participation for adolescents with ASD in vocational settings. The results are particularly notable, given that the participant had only limited exposure to the app (i.e., once a week). Despite this, the use of video VSDs was effective and suggests the potential for a greater impact had James had more frequent access to the app. Compared to previous research that was effective in utilizing video prompting to teach vocational skills to individuals with disabilities (Bereznak et al., 2012; Kellems & Morningstar, 2012; Van Laarhoven, Johnson, Van Laarhoven-Meyers, Grider, & Grider, 2009), use of the video VSD app in this study produced similar results in terms of effectiveness, but also supported communication within the vocational task. This study extends the existing video modeling and video-prompting research by demonstrating the positive impact of integrating communication supports within the video-prompting technology.

A number of factors may have contributed to the effectiveness of the interactive video VSD in supporting both the acquisition of new skills and communication for the participant. To support the learning of new skills, the video VSD app provides video prompting to support independent task completion. As part of a video-prompting approach, the app supports the use of task analysis to break complex tasks into smaller units which are presented as short video clips, and the app provides a pause after the playing of each video clip to prompt completion of the required step (e.g., Sigafoos et al., 2007). With the video VSD intervention, James was able to learn the targeted tasks and respond to cues within the environment (including the video VSD) rather than relying on prompts from an adult (Macduff et al., 2001).

Unlike most video-prompting apps, the video VSD app provides integrated support for communication. Specifically, the video VSD app depicts vocabulary (i.e., hot spots) within meaningful and familiar contexts (i.e., VSDs during the video), providing communication supports when they are needed within a particular activity (Light, McNaughton, Jakobs, & Hershberge, 2014; O'Neill, Light, & McNaughton, 2017). James successfully used the embedded hot spots to communicate during the tasks. Further, the results were maintained over a period of time, and there is some initial evidence of generalization to an untrained activity (i.e., paper shredding).

Instructional Implications

The results of this study suggest that video VSDs may provide a solution that combines video prompting and communication supports with the goal of increasing independent participation within vocational settings in real-world contexts for individuals with ASD and CCN. This technology may increase employment and community opportunities for individuals with ASD and CCN by increasing independence and decreasing reliance on prompting from adults. By providing the necessary support to not only complete the steps within the task but also fulfill communication opportunities within the work or community setting, these individuals may be able to participate in a wider variety of employment activities. The generalization data provide preliminary evidence that once an individual is taught to use video VSDs within several tasks, the individual may be able to make use of the technology to independently learn new tasks. Using an app on mobile technology may be a particularly effective means of intervention as mobile technology is practical, affordable, and typically viewed as socially acceptable for individuals with disabilities (McNaughton & Light, 2013). Although the software used in this study (EasyVSD, see Note 4) is only available for research purposes, GoVisual[6] is a commercially available application that supports the creation and use of video VSDs.

Limitations and Future Research Directions

Despite the contribution of this study, the research is still preliminary in nature and the study has several limitations that should be considered in interpreting the results. This study occurred in a single prevocational context (i.e., elementary library) and only included one participant. Furthermore, intervention for Task 3 and generalization probes were cut short because of the end of the school year and the participant did not show mastery for the generalization task. Additionally, social validity was only assessed for one staff member working with the student. Future studies should investigate the use of video VSDs with a greater range of participants and in other vocational and community settings. Future research is also required to investigate how best to support use of the app, specifically to determine how much and what type of instructional support is required. In addition, information on social validity measures should be elicited from the participant as well as other members of the team. Finally, future research should probe long-term maintenance as well as generalization and should investigate long-term strategies to transition participants from step-by-step video prompting to more fluent task performance.

Conclusion

The use of the interactive video VSDs supported a young man with ASD and CCN in learning to complete targeted vocational skills independently and in communicating with others in the workplace. The low level of employment observed for individuals with ASD and CCN highlights the need for more effective supports to facilitate successful transition into the workplace (Hedley et al., 2017; Pillay & Brownlow, 2017). The results of this study suggest that videos with integrated VSDs may provide appropriate communication and participation supports during employment activities and thereby contribute to greater independence and improved the quality of life for persons with ASD and CCN.

Appendix

Table A1. Social Validity Questionnaire.

Question	Response From Paraprofessional
Do you think the student's skills improved as a result of the intervention?	Yes
Did it provide an effective way for him to complete the task?	Yes
Did it provide an efficient way for him to complete the task?	Yes
Was it an appropriate way for him to complete the task?	Yes
Do you think the student's communication skills improved as a result of the intervention?	Yes
Did it provide an effective way for him to complete the task?	Yes, absolutely. It really helped him with communicating.
Did it provide an efficient way for him to complete the task?	Yes
Was it an appropriate way for him to complete the task?	Yes
Do you think the student enjoyed participating in the tasks?	Yes, I do. He really did. He likes the technology.
If another para-educator asked you about this, what would you say?	I would say it was an awesome program that really worked for the student. For someone who is nonverbal and can follow step-by-step instructions. It really was a nice program.
What would you say (if anything) was a major challenge to the intervention?	Some of the tasks he enjoyed doing more than others and if you let him, he would just do one thing over and over. So, I think the biggest challenge was getting him excited about doing the other tasks that he didn't enjoy doing as much. But, he did well with those tasks.
What (if anything) do you feel was the major benefit of the intervention?	I think it really helped him with step-by-step skills, it gave him confidence, and it helped him to see that he is capable of doing these things. It also showed the staff the he is capable of following these directions and completing the task.
Is there anything else you would like to add?	It was an awesome program, for him it really worked.

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Notes

1. GoTalk NOW is an augmentative and alternative communication (AAC) application created by Attainment Company (https://www.attainmentcompany.com/gotalk-now).
2. Snap Scene is an AAC application created by Tobii Dynavox (http://mytobiidynavox.com/Store/SnapScene).
3. Samsung Galaxy Note Pro 7® is an android tablet computer developed by Samsung Electronics (http://www.samsung.com).
4. EasyVSD is an AAC application created by InvoTek, Inc. (http://www.invotek.org/).
5. iMovie is a video-editing software application created by Apple (https://www.apple.com/imovie/).
6. GoVisual is an AAC application created by Attainment Company (https://www.attainmentcompany.com/govisual).

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