A COMPARISON OF ACTIVITY SCHEDULE PROCEDURES TO TEACH SOCIAL SKILLS TO PRESCHOOLERS WITH AUTISM SPECTRUM DISORDER

By

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ABSTRACT

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Individuals with autism spectrum disorder (ASD) have marked deficits in social communication and social interaction skills. In the present investigation, activity schedules and video modeling were combined to assess their impact on social interaction skills of children with ASD. An adapted alternating treatment design was nested within a multiple probe across participants design to first assess the effectiveness of each procedure to teach showing to four preschool aged participants with ASD and then to compare the differential effects of electronic versus video enhanced activity schedules. Two participants acquired social skills faster in the video enhanced activity schedule condition, one participant acquired social skills faster in the electronic activity schedule condition, and one participant learned at a comparable rate across interventions.

Keywords: autism spectrum disorder, activity schedules, social skills, video modeling

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Introduction

Typically developing children, as young as 3 to 4 years of age, naturally interact with their peers and develop social skills with little to no intensive adult-led instruction. Conversely, individuals with autism spectrum disorder (ASD) have marked deficits in social communication and social interaction skills (American Psychiatric Association, 2013). If untreated, these social deficits often persist and worsen throughout the course of the individual's lifetime. Due to social interaction deficits, children with ASD often rely on explicit and systematic instruction (for a definition, see Plavnick, Marchand-Martella, Martella, Thompson, & Wood, 2015) to initiate social interactions with peers or adults (McConnell, 2002). Social communication and social interaction skills are core deficit areas for individuals with ASD, who must be explicitly taught to independently engage in social behaviors with typically developing children as early as possible (Koegel, Koegel, Frea, & Fredeen, 2001).

Video modeling is an evidence-based intervention for children with ASD and has been used to teach a wide variety of new skills, including social interaction (Bellini & Akullian, 2007). Video modeling is based on observational learning theory and is an intervention in which the individual watches a video of the desired behavior and then imitates the behavior(s) seen in the video. Video modeling has shown to be especially potent for teaching social skills. For example, Nikopoulos and Keenan (2004) used video modeling to teach social initiations to play to three participants between 7 and 9 years old. The video models depicted a typically developing peer grabbing the hand of the experimenter and inviting them to play. Following the video model, the participant with ASD had the opportunity to engage in the target behavior with the experimenter as a social partner. All participants demonstrated improved performance in social behavior, including decreased latency to initiate an interaction and increased amount of

time spent playing appropriately with the toys with a social partner. The results suggest video modeling can be a successful and potent intervention for teaching social initiations to children with ASD.

Plavnick, MacFarland, and Ferreri (2015) similarly taught play behavior using video modeling, though extended the intervention to teach pre-school children with ASD to play with one another as opposed to adults. Plavnick and colleagues showed the video to a small group of children, then provided each participant with an opportunity to demonstrate the modeled behaviors of sharing toys and joining play in progress. The video modeling clips were 20 to 30 s long and depicted typically developing similar-aged peers engaging in the target behavior. Results showed that video modeling was a successful intervention to teach young children to appropriately join play that is already in progress. The investigation showed that video modeling can be used to teach peer directed social targets (e.g., joining in play with peers) to preschoolers with ASD.

Despite its effectiveness in teaching children with ASD to engage in social behavior with peers, video modeling as administered in prior research is limited in that it requires ongoing mediation by an adult to show the video and contrive a social environment (e.g., Plavnick et al., 2015). When teaching any skill, prompting should be faded out as soon as possible to avoid individuals becoming reliant on prompts to perform the skill. Furthermore, there might be ways to strengthen video modeling to further increase independence of children with ASD.

Activity schedules are an evidence-based intervention for children with ASD (Knight, Sartini, & Spriggs, 2015) that can increase independence (Milley & Machalicek, 2012). Activity schedules usually consist of a notebook with pictorial, symbolic, or textual cues to serve as a discriminative stimulus for the learner to engage in a chain of behaviors laid out within the pages

of the schedule (Wacker & Berg, 1983). Activity schedules can guide a child through a variety of activities, such as puzzles, routines, and playing with toys or certain areas of a classroom (McClannahan & Krantz, 2010).

Activity schedules have also been used as an intervention to increase social initiations among children with ASD (Stevenson, Krantz, and McClannahan, 2000). Stevenson, et al. (2000) used activity schedules and audiotaped scripts to increase social initiations among four individuals with ASD between 10 and 15 years old. The audiotaped scripts were created using an audio card reader, which a participant could slide a card through to hear a recording, to prompt participants to initiate target vocalizations with a recipient. Activity schedules, in combination with scripts and script fading procedures, have been successful in teaching many children with ASD to independently initiate vocal interactions with peers and adults (Akers., Pyle., Higbee, Pyle, & Gerencser, 2016; Brodhead, Higbee, Pollard, Akers, & Gerencser., 2014; Krantz & McClannahan, 1993; McClannahan, & Krantz, 2010; Stevenson, Krantz, & McClannahan, 2000).

An advantage of activity schedules is that they can be broadly applied to individuals with ASD, including pre-school aged children (Akers, Higbee, Pollard, Pellegrino, & Gerencser, 2016). Akers and colleagues examined the effects of activity schedules on independent appropriate play activities with young children with ASD in a playground environment. The participants were three boys between the ages of four and five who demonstrated fluent schedule following behaviors within a classroom setting prior to the beginning of the study. Akers and colleagues used activity schedules to increase the number of appropriate play activities on the playground. Researchers also examined the effects of the intervention on the percentage of schedule components completed correctly and independently. The results suggest that an activity

schedule is a successful intervention to increase appropriate play activities in a playground environment and that preschool aged children can independently follow an activity schedule in a variety of environments.

Traditional activity schedules are typically used to teach independent performance of skills already in a learner's repertoire within a classroom, clinic, or home environment (McClannahan & Krantz, 2010). Therefore, traditional activity schedules do not commonly teach children how to engage in new activities. However, based on the respective success of video modeling and activity schedules to teach social skills and independence, there is potential to combine the interventions to teach children with ASD to independently perform new social skills. Such an approach has been described, though not empirically examined in the extant literature (Stromer, Kimball, Kinney, & Taylor, 2006), and technological advances suggest doing so via tablet computing might be relatively simple for interventionists (Brodhead, Courtney, & Thaxton, 2018; Carlile, Reeve, Reeve, & DeBar, 2013; and Spriggs, Knight, & Sherrow, 2015).

One form of technology based activity schedule is electronic activity schedules. Electronic activity schedules are activity schedules embedded into technology (e.g. tablet, computer, or smart phone) in which each page of the schedule depicts a static picture or text as the discriminative stimulus. Electronic activity schedules have been used to increase variability in application use (Brodhead, Courtney, & Thaxton, 2018) and increase independent leisure activities in the classroom (Carlile, Reeve, Reeve, & DeBar, 2013). Video enhanced activity schedules are activity schedules embedded into technology in which each page of the schedule has a video model embedded to have a video model as the discriminative stimulus.

Stromer and colleagues (2006) discussed a case study in which a seven-year-old girl with ASD used a PowerPoint® based activity schedule with video modeling to improve independent

play, sociodramatic play, and play bids (e.g., invitations to play). The authors reported the participant successfully learned how to follow the video enhanced activity schedule and then generalized the skills learned within the video enhanced activity schedule to a traditional paper based activity schedule. This case study suggests that a video enhanced activity schedule may be a successful intervention to improve a variety of play skills with anecdotal support, but experimental confirmation would strengthen the case for video enhanced activity schedules.

Although not used to teach social interactions, Spriggs, Knight, and Sherrow (2015) showed that video modeling within an activity schedule was an efficacious procedure for teaching individuals with ASD to independently perform novel tasks. The authors examined the effects of video modeling embedded into an activity schedule on independence and performance on novel tasks, such as data entry, solving algebraic equations with a calculator, and using a graphic organizer to write a paragraph. Two participants acquired the skills after watching the complete video, while the remaining two needed the videos broken down into smaller components in order to learn all steps of the target behaviors. All participants demonstrated generalization to novel skills after the training condition. These results suggest that an activity schedule with embedded video models can lead to increased independence and may be an efficient way to teach novel skills while ensuring student independence.

An intervention package of activity schedules and video modeling has potential for teaching independent social skills to children with ASD, though very few studies have systematically measured the effects of video embedded activity schedules on independence. In addition, minimal research has examined the effects of technology-based interventions on acquisition of social skills among young children with ASD (Kagohara et al., 2013). Therefore, the purpose of the present investigation is to examine the effects of video enhanced activity

schedules with least to most prompting on the acquisition of social initiations among children with ASD. A second purpose was to compare the rate of acquisition of social initiations when children were taught using video enhanced schedules compared to electronic schedules only. The specific research questions explored in the current investigation are what are the effects of electronic and video enhanced activity schedules with least to most prompting on the acquisition of social initiations and which, if any, intervention leads to more rapid independent social initiations.

Method

Participants and Setting

Earl (4 years old), Milly (5 years old), Alex (4 years old), and Oscar (3 years old) participated in this study. All participants had a primary diagnosis of ASD and attended a university based behavior-analytic early intensive behavior intervention (EIBI) clinic for children with ASD where they received thirty hours of applied behavior analysis therapy per week. Prior to and throughout the present investigation, Earl, and Alex spent three hours a day in an inclusive general education environment, while Milly and Oscar spent 30 to 45-minutes in an inclusive general education environment. Earl, Alex, and Oscar found peers reinforcing with little to no direction from adults; in addition, all three participants would commonly engage in social interactions with peers daily without adult prompting. Milly found some reinforcing value in peers, but commonly needed adult prompting and direction to engage in social interactions with peers in which she didn't directly benefit from (e.g., requesting items from peers). All participants had previous experience using video enhanced activity schedules and electronic activity schedules and could independently complete video enhanced and electronic activity schedules with at least two non-social activities. All participants had a verbal repertoire

consisting of the ability to echo or speak in one to four word phrases. Children who did not yet meet mastery criteria for electronic and video enhanced activity schedules were excluded from the study.

All sessions took place within the EIBI therapy classroom during regular therapy hours. The EIBI room typically had eight students present with one behavior technician per child. During research sessions, the seven other children went about their regular programming. The room was physically set up with common features of an EIBI therapy room and a typical preschool classroom. There was an open space in the room for free play, along with several individual tables and chairs for therapy sessions, two large group tables and chairs, a book shelf, a TV, and a shelf designated for activity schedule materials. The activity schedule shelf consisted of toys and activities frequently used during activity schedules, that were rotated and changed weekly.

Materials

Electronic activity schedule. Each electronic activity schedule was created with the Apple® Keynote® iPad application, similar to schedules used by Brodhead, Courtney, & Thaxton (2018). Figure 1 depicts an example of an electronic activity schedule as it appeared in Keynote®. All Keynote® slides during this condition had light blue backgrounds to indicate it was an electronic activity schedule. The first slide within the Keynote® was always a picture of the participant with text indicating that it was that participant's schedule (e.g., text reading "Jenny's Schedule" with a photo of Jenny). To access remaining slides, the child clicked the next slide from within the side bar on the left side of Keynote®. Each slide of the activity schedule following the title page contained a static picture to indicate the next step of the schedule, with five slides total for the activity schedule. Textual prompts within the electronic activity schedule

were pre-taught and used to prompt verbal behavior during the social skills sequence. Pre-teaching sessions required the participant to point to and vocal verbally say the words from the script on a slide within the Apple® Keynote® iPad application. Participants were taught to read the script with a physical prompt for the point and an echoic model for the verbal behavior. Mastery criteria was 80% accuracy across three sessions. If a textual prompt was included, it was located on the same slide as the photo of the activity and the peer.

Video enhanced activity schedule. Each video enhanced activity schedule was created with the Apple® Keynote® iPad application. Formatting of video enhanced activity schedules were identical to electronic activity schedules except all Keynote® slides during this condition had light red backgrounds to indicate it was a video enhanced activity schedule. Similar to the electronic activity schedule condition, the first slide during the video enhanced activity schedule condition was always a picture of the participant with text indicating that it was that participant's schedule (e.g., Text reading "Jenny's Schedule" with a photo of Jenny). To access remaining slides, the child clicked the next slide from within the side bar on the left side of Keynote®, with five slides total for the activity schedule. The video models on each slide would begin to play once the slide was selected. The researcher created the video models by recording adults engaging in the target behaviors with the specific materials used during the study for each step of the activity schedule.

Measurement

Participants were taught two different topographies of one social skill, each topography assigned to one of the two intervention conditions. The target social skill behavior taught was showing. Showing was defined as the participant orienting his or her body towards a social partner, emitting a request for the attention of the social partner (e.g., saying hey and the

partner's name, such as "Hey Ariel!"), and emitting a vocal verbal label of something in their possession (e.g., "Puzzle is done," or "I finished my puzzle!"). The primary dependent variable was accurate performance of the social behavior, as measured by a task analysis that included each component of the behavior described.

Participants were assessed on whether they used the volume of speech corresponding to the distance they were from the social partner (e.g., using a conversational volume when close to individual, and raising volume if further away from individual), modulation in tone of voice, and having a pleasant affect (e.g., smiling). Volume, modulation, and affect were coded as under exaggerated, appropriate, or over exaggerated; responses were only scored as correct when coded as *appropriate*.

Prior to the implementation of the present investigation, the researcher piloted measurement procedures to assess whether two independent observers can obtain interobserver reliability (IOA) above 90% for coding volume, modulation, and affect. If the observers could not reach 90% agreement during the pilot, the present study was to only include orienting toward a social partner, obtaining attention, and the vocalization associated with showing or commenting when scoring social behaviors. The pilot resulted in high IOA and the inclusion of the measurement in the current investigation. Table 1 depicts the operational definition for all target skills along with how each skill was measured.

The secondary dependent variable was the quality measures for the social skill and the percentage of steps completed correctly and independently from a task analysis of the entire activity schedule. Each step of the task analysis was scored as either correct or incorrect, and the percentage of steps completed correctly and independently was calculated by dividing the total number of correct steps by the total number of steps of the task analysis.

The behaviors were assigned in a manner that ensured two participants were taught the topography associated with the same activity under one intervention condition, while the other two participants were taught under the other intervention condition. The same occurred for the other topography. This tactic controlled for threats to internal validity as a result of one behavior being easier to acquire than another. To control for one target behavior being easier than the other, participants were paired up by placing participants with the two highest and the two lowest Verbal Behavior Milestones Assessment and Placement Program scores together. Table 2 depicts the assignment of topographies to intervention condition for each participant. The social behavior task analysis data sheet is included as Appendix A.

Interobserver agreement (IOA) was recorded during at least 30% of sessions evenly distributed across conditions and participants. IOA was completed by trained research assistants that regularly worked with the clients. When calculating IOA for the present investigation, observers compared coding step by step of the task analyses scores. An agreement was defined as both observers coding the same prompt level (-, P-, P+, or +) for a step of the task analysis, and a disagreement was defined as observers scoring different prompt levels for a step of the task analysis. A "-" was scored for a trial in which an error occurred. A "P-" was scored for a trial in which an ineffective prompt was used and an error occurred. A "P+" was scored for a trial in which an effective prompt was used. A "+" was scored for a trial in which the behavior was completed correctly and independently. IOA was calculated by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100. IOA was 98% (range, 83-100%) for Earl, 99.7% (range, 96-100%) for Milly, 99.5% (range, 95-100%) for Alex, and 98.8% (range, 88-100%) for Oscar.

Experimental Design

An adapted alternating treatment design was nested within a multiple probe design to examine and compare the effects of each schedule procedure on the acquisition of social skills. Participants were transitioned between the baseline probes and intervention in a systematic manner. Participant 1 transitioned from baseline to the activity schedule probe and intervention conditions following at least five stable baseline sessions. Participant 2, Participant 3, and Participant 4 continued with baseline probes until Participant 1 had two sessions with stable responding that was higher than the baseline mean within one of the two intervention conditions. At this time, Participant 2 transitioned into the activity schedule probe and intervention conditions. A similar decision-making process was repeated for transitioning Participant 3 and Participant 4 into the intervention conditions.

A multiple probe design was used because it was ideal to answer the first research question: what are the effects of electronic and video enhanced activity schedules with least to most prompting on the acquisition of social initiations. The multiple probe design allows for a demonstration of stable baseline responding with an intermittent measurement of the target behavior during the baseline conditions (Horner & Baer, 1978). It was hypothesized that low to zero levels of the target behavior would be performed during baseline. Therefore, the multiple probe design ensured that participants did not have to endure a long baseline condition with an unnecessary number of sessions occurring before an intervention is put into place.

The adapted alternating treatment design (AATD) allowed for the comparison of the two activity schedule procedures on two similar non-reversible behaviors. An AATD is commonly used to compare the efficiency of two interventions, so an AATD lends itself to the purpose of

this study (comparing electronic activity schedules to video enhanced activity schedules) (Gast & Ledford, 2014).

Within the transfer of training condition, the treatment that showed to be most effective was implemented with each participant to then teach the skill from the inferior intervention. This demonstrated the efficiency of the optimal treatment to teach social skills. A complete description and comparison of conditions is depicted in Table 3.

The alternation of the intervention conditions was decided by flipping a coin right before the session. However, one intervention condition could only be conducted three consecutive times based on flipping a coin. The researcher planned to switch conditions had four consecutive coin tosses occurred, which did not happen. Up to three sessions could be administered in one day with at least one hour between each session.

Procedures

Baseline. The baseline condition was designed to assess participants' response to vocal instruction that would later be included in the activity schedule interventions. Sessions began with the researcher giving the verbal instruction "Go do [a ring stacker or a puzzle], and show a friend." After the verbal instruction was given to the participant, no further prompts were provided. If the child performed all the target behaviors during the baseline sessions, no contrived reinforcer was delivered; however, the receiving peer involved in the social exchange would cheer or provide generalized social praise. If the child didn't perform the task, reinforcement was withheld. If the participant did not begin to engage in the initial activity within the sequence within one minute, the session was terminated. If the child started following the instructions but stopped engaging in corresponding behaviors at any time for one minute, the session was terminated.

Activity schedule probe. The purpose of the activity schedule probe is to see if the presence of the activity schedule alone affects the performance of the target behavior. The same procedures from baseline were used, but the iPad with both the electronic activity schedule and video enhanced activity schedule was present on the table where the session was held.

Electronic activity schedule. The purpose of the electronic activity schedule condition was to assess the effect of static pictures with textual prompts on independent and quality social interactions. The electronic activity schedule condition controls for the possible confound that the presentation of technology, which is inherent in using video-enhanced activity schedules, may promote an increase in independent schedule following behavior. All participants had a prior history with following electronic activity schedules without social interactions independently with at least 80% accuracy for three sessions across different days. Sessions lasted anywhere between five to eight minutes long.

All sessions began with the researcher unlocking the iPad, gaining eye contact from the participant, giving the verbal instruction "Go do [a ring stacker or a puzzle], and show a friend," and handing the unlocked iPad to the participant. After the participant took the iPad from the researcher, the researcher faded out to the independent level of the prompting hierarchy (≥1.524m away from participant) and progressed through the system of least to most prompts as needed.

Due to their prior history with the activity schedule, a system of least to most prompts was used to teach schedule components. The least to most prompting hierarchy ensured a minimal amount of prompting was used while assessing the extent to which the activity schedule provided actual instruction. The system of least to most prompts used throughout the teaching process progressed as follows: 1) independent, 2) redirection without physical contact with

participant (e.g. blocking a pathway without making physical contact with participant), 3) manual guidance on shoulder or back, 4) manual guidance between shoulder and elbow, 5) manual guidance between elbow and wrist, and 6) hand over hand manual guidance. During the social skills sequence of the activity schedule the same least to most prompting hierarchy was used for physical behaviors (e.g., tapping the intended audience), and vocal models were added to prompt verbal behavior. The system of least to most prompts for echoic prompts progressed as follows: 1) independent, 2) partial echoic model with 1/4 of verbal phrase provided, 3) partial echoic model with 1/2 of verbal phrase provided, 4) partial echoic model with 3/4 of verbal phrase provided, and 5) full echoic model. No vocal praise or tangible reinforcement was given following individual schedule components or following a completed schedule. Similar to research completed by Wu, Wheaton, and Cannella-Malone (2016), the researcher started the least to most prompting hierarchy at the independent level and progressed through each prompt level after 5 seconds of an ineffective prompt level (e.g., no response or error). If the prompts provided were not effective, termination criteria was identical to baseline.

All errors were interrupted, blocked, or redirected when possible. If an error did occur, an error correction procedure was implemented. The error correction procedure was the trial where the error occurred was immediately reset and the participant was provided a full prompt at the most intrusive level to complete the trial correctly. For example, if the participant retrieved the wrong materials, the experimenter would fully physically prompt the participant to return the incorrect materials and retrieve the correct materials.

Video enhanced activity schedule. The purpose of the video enhanced activity schedule was to assess the effect of a video model embedded into an activity schedule on independent social interactions. All participants had a prior history with independently following video

enhanced activity schedules without social interactions with at least 80% accuracy for three sessions across different days. The video enhanced condition was identical to the electronic condition except that a video model of an adult performing the target social interaction was presented instead of a picture with a textual prompt on each slide as in the electronic condition. Participants were allowed to watch the video on each slide up to two times before being redirected away from the schedule to being the next step in the behavior chain.

Transfer of training. The purpose of the transfer of training condition was to assess the effect of placing the behaviors attempted in the inferior intervention condition into the optimal treatment condition. In this condition, the topography from the intervention that did not reach mastery criteria first was embedded into the intervention that lead to quicker acquisition of skills.

Treatment Fidelity

Treatment fidelity data was collected for 30% of sessions for each condition and participant. Procedures for both the electronic and video activity schedules, as well as baseline, were broken down into components and each step was scored by a trained research assistant while the main author implemented the intervention. Treatment fidelity was calculated by dividing the number of steps completed correctly by the sum of steps completed correctly and incorrectly and multiplying by 100. Appendix B, Appendix C, and Appendix D depict the treatment fidelity checklist for each condition with the optimal treatment condition using the same checklist as intervention. Treatment fidelity was 100% across all participants and conditions.

Results

Figure 2 depicts the number of components of the social skills task analysis completed correctly and independently for the four participants. Earl performed none of the social skill

components across schedules in each session in baseline and in the schedule probe conditions. Once he entered into the intervention condition, Earl's mean responding was 0.75 (range, 0 to 2) social skill components in the electronic activity schedule and 2.5 (range, 1 to 3) social skill components in the video enhanced activity schedule. He performed the social skill independently in the second session and met mastery criteria after four sessions in the video activity schedule condition yet did not independently perform all components of the social skill during any of the electronic activity schedule sessions. In the transfer of training condition, Earl performed 3 social skill components when the target behavior from the original electronic activity schedule condition was put into a video enhanced activity schedule.

During baseline and schedule probe conditions, Milly performed no social skill components across schedules in each session. During the intervention condition, Milly's mean responding was 1.58 (range, 0 to 3) social skill components in the electronic activity schedule condition and 2.08 (range, 0 to 3) social skill components in the video enhanced activity schedule condition. Her responding was variable in both the electronic activity schedule and the video enhanced activity schedule, but Milly independently performed all components of the social skill in the fifth video enhanced activity schedule session and reached mastery within 12 sessions. Conversely, she independently performed the social skill only one time during the electronic activity schedule condition, during the eighth session. In the transfer of training condition, Milly performed 3 social skill components when the target behavior from the original electronic activity schedule condition was put into a video enhanced activity schedule.

During baseline, Alex's mean responding was 0.40 (range, 0 to 1) social skill components for the electronic activity schedule and was 0.60 (range, 0 to 1) social skill components for the video enhanced activity schedule but became stable at 0 social skill components performed in the

last three probes for each activity schedule. Alex's variable responding at the beginning of baseline was due to problem behavior and Alex engaging in parts of the defined social interaction during baseline. In most sessions, he was orienting his body towards his peer and engaging in social behavior with a peer or adult in the room but not emitting the target vocalization. In the schedule probe conditions, Alex performed no social skill components. After transition to the intervention condition, responding increased immediately to 3 social skill components across all video enhanced activity schedule sessions and a mean of 2.75 social skill components (range, 2 to 3) in the electronic activity schedule condition. A transfer of training condition was not conducted with Alex because he reached mastery criteria for both interventions, making the transfer of training condition unnecessary.

Oscar showed stable responding with no social skill components performed throughout baseline and schedule probe conditions. During the electronic activity schedule and video enhanced activity schedule conditions, Oscar showed a steady increase in responding across intervention conditions. He performed the social skill independently during the sixth electronic activity schedule session and reached mastery criteria in eight sessions, with a mean responding of 1.88 (range, 0 to 3) social skill components. In the video enhanced activity schedule condition, Oscar showed similarities in responding by performing the social skill independently in the seventh session and with an overall mean of 1.5 (range, 0 to 3) social skill components. However, he did not reach mastery during the video enhanced condition. In the transfer of training condition, he took two sessions to reach 3 social skill components (with responding ranging from 2 to 3 social skill components) when the target behavior from the original video enhanced activity schedule condition was put into an electronic activity schedule.

Table 4 depicts the results from the quality measures of the social skill components and overall correct and independent schedule following behaviors. Earl performed 0 appropriate quality measures in all baseline and schedule probe sessions, a mean of 2.75 (range, 2 to 3) appropriate quality measures in the electronic activity schedule, and 2 appropriate quality measures across all intervention conditions for the video enhanced activity schedule. Earl's overall schedule following behavior increased for both activity schedules with a mean of 76% (range, 70-86%) and 85% (range, 74-100%) for electronic activity schedules and video enhanced activity schedules, respectively.

Milly performed 0 appropriate quality measures in all baseline and schedule probe sessions and a range of 2 to 3 quality measures for both schedule types with a slightly higher average score in the video enhanced activity schedule condition. Her mean responding was 2.75 appropriate quality measures in the electronic activity schedule condition and 2.77 appropriate quality measures in the video enhanced activity schedule condition. Milly's overall schedule following behavior increased for both activity schedules with a mean of 87% (range, 76-95%) in the electronic activity schedule condition and a mean of 90% (range, 71-100%) in the video enhanced activity schedule condition.

Alex performed a mean of 1 appropriate quality measures in the electronic activity schedule baseline condition (range, 0-3), a mean of 1.4 appropriate quality measures in the video enhanced activity schedule baseline condition (range, 0-3), and 3 quality measures for all sessions across both intervention conditions. Alex's overall schedule following behavior was a mean of 80% (range, 68-95%) in the electronic activity schedule condition and 66% (range, 60-75%) in the video enhanced activity schedule condition.

Oscar performed 0 appropriate quality measures in all baseline and schedule probe sessions, a mean of 2.83 (range, 2 to 3) appropriate quality measures in the electronic activity schedule, and 3 appropriate quality measures across all intervention conditions for the video enhanced activity schedule. Oscar's overall schedule following behavior increased for both activity schedules with a mean of 85% (range, 75-95%) and 76% (range, 55-90%) for electronic activity schedules and video enhanced activity schedules respectively.

Discussion

The results of the present investigation suggest that both electronic activity schedules and video enhanced activity schedules, combined with least-to-most prompting, are successful interventions for teaching social skills to preschoolers with ASD. Three out of the four participants performed all social skill components in both conditions at least once while also reaching mastery criteria in one of the two intervention conditions. These results suggest that both interventions led to acquisition of social skills in most cases.

The present investigation offers support to emerging research showing that technology, such as the Apple iPad®, can be used during activity schedules for children with ASD (Carlile, Reeve, Reeve, & DeBar, 2013; Spriggs, Knight, & Sherrow, 2015; and Stromer, Kimball, Kinney, & Taylor, 2006). This study extends research on electronic activity schedules conducted by Brodhead, Courtney, and Thaxton (2018), in which the Apple® Keynote® iPad application was used to promote varied application use in children with ASD. The present investigation demonstrates that activity schedules created within the Apple® Keynote® iPad application can be accurately followed by preschoolers with ASD in an EIBI setting; and furthermore, such activity schedules can be used to teach social skills. The results confirm and extend prior research on video enhanced activity schedules for children with ASD (Spriggs, et al., 2015;

Stromer et al., 2006). The present investigation provides empirical support for Stromer and colleagues' case study. All participants in the present investigation were successful in learning the targeted social skill from the video enhanced activity schedule, demonstrating that this type of activity schedule can be effective for children with ASD with varied skill levels. The results also extend the findings of Spriggs and colleagues (2015), who demonstrated the efficacy of video enhanced activity schedules for teaching a variety of skills to high schoolers with ASD. The present investigation extended this research to new skills (social skills), environments (EIBI), and age groups (preschool), which suggests that video enhanced activity schedules may be an effective intervention to teach a variety of skills across settings and to a diverse group of individuals with ASD.Although both interventions led to positive outcomes, there were observed differences in the efficiency of the video enhanced activity schedule compared to the electronic activity schedule. Two participants, Earl and Milly, acquired skills more rapidly in the video enhanced activity schedule condition. Interestingly, Earl never independently performed the social skill during the electronic activity schedule condition and Milly only performed it one time, substantially later than her first demonstration in the video enhanced condition. Alternatively, Oscar acquired the social skill and met mastery criteria fastest in the electronic condition, but demonstrated independent performance at approximately the same time in the video enhanced condition. These outcomes might speak to efficiency at an individualized level; some children with ASD might learn skills substantially faster in the video enhanced condition, whereas other children might be able to learn skills in either condition.

Embedding a video model within an activity schedule provides a mechanism of instruction that potentially removes the need for an adult to provide an additional prompt. As depicted in the transfer of training condition, Earl and Milly both acquired the social skill in one

session when transferred into the video enhanced activity schedule, whereas Oscar's responding in the transfer of training condition was slower, taking two sessions to reach a performance of three social skill components. This suggests using a video model may lead to less adult prompting and more independence. When a video enhanced activity schedule is more efficient for a learner, it could facilitate more rapid learning when new skills are embedded into the schedule than electronic activity schedules as demonstrated in the transfer of training condition.

Despite some observed benefit of the video enhanced activity schedule, one barrier to using this approach may be the time it takes to create the video model. The results suggest that both interventions worked well for all participants for overall schedule following behavior, and in some cases to teach the targeted social skills. As such, service providers may way want to examine the time requirements of each intervention when deciding between electronic and video enhanced activity schedules. Though it takes more time to prepare materials, video enhanced activity schedules could be optimal for complex behaviors that are difficult to portray with pictures and text. Additionally, video enhanced schedules may be better for teaching social skills to children who cannot read textual prompts or become dependent on vocal prompts provided by adults. Though electronic activity schedules required less material preparation, they required a more involved pre-teaching procedure in order to place textual prompts into the schedule. Therefore, it's important for service providers to weigh the differences in time commitments to material preparation and pre-teaching before deciding between the two procedures.

Although the results suggest that both electronic activity schedules and video enhanced activity schedules are successful interventions for teaching social skills to preschoolers with ASD, there were limitations to the present investigation. First, once the skill was acquired, the activity schedule was not faded out. It would be useful to see if a new social skill acquired within

an activity schedule could then generalize to the discriminative stimuli given before the schedule (e.g., does the participant complete a puzzle and show a friend following the verbal instruction "Go do a puzzle, and show a friend"). However, instead of fading an activity schedule out completely, activity schedules are often transitioned into more manageable and simple types of schedules (e.g., written lists) (McClannahan & Krantz, 2010); therefore, future research might examine methods to transition into simple schedules that can be easily managed long term.

Another limitation to this study was that the quality measure might not have been a valid measure of the quality of social interaction. IOA did remain at high percentages throughout the study, which shows that two individuals reliably recorded the same rating for the measurements. Yet one potential problem with using a quality measure was that participants could perform the quality components without engaging in the correct social skill or after being prompted to engage in the social skill, as long as they engaged in some sort of social exchange. Therefore, high scores might not always represent the same overall social performance. Despite the limitation in the present investigation, quality of social interaction is an important aspect of teaching social behavior to children with ASD. Future research should seek objective and valid measurement systems for evaluating quality of social behavior.

Finally, it is important to consider possible multiple treatment interference. With alternating treatment designs, there's a possibility of one intervention affecting the results in the other intervention administered (McGonigle, Rojahn, Dixon, & Strain, 1987). A number of elements were considered prior to intervention to account for the possibility of multiple treatment interference, including using different discriminative stimuli between intervention conditions and having the vocal verbal phrases be specific to one intervention condition for each participant. A suggestion for future research to further control for multiple treatment interference

would be to teach two different but equivalent skills when comparing activity schedule procedures.

A suggestion for future research is to examine the effects of video enhanced activity schedules on the acquisition of a variety of new skills. Video modeling literature suggests that video modeling is an effective and efficient intervention for teaching new skills, particularly social skills; however, it would be beneficial to know other skills that are ideal for a video enhanced activity schedule.

Overall, the results from the present investigation suggest that both electronic and video enhanced activity schedules may be successful when paired with least to most prompting in teaching new social skills to preschoolers with ASD. While both activity schedules were successful, video enhanced activity schedules may be more effective in some situations, though additional research is needed to determine which procedure is most efficient for a specific learner in a specific situation. These results ultimately further the vast literature demonstrating the overall efficiency of activity schedules and offer procedures for leveraging technology to broaden the range of skills researchers and providers might be able to teach using activity schedules.

APPENDICES

Appendix A: Activity Schedule Task Analysis

Thesis Research: Activity Schedule Task Analysis			
Participant (Circle one)		1 2	3 4
Date			
Session #			
Researcher Initials			
Condition		E V	E V
Trial #	**Steps**	**Prompting Data**	
1	Takes iPad	NR E P- P+ +	NR E P- P+ +
2	Finds an area to sit (on floor or at table)	NR E P- P+ +	NR E P- P+ +
3	Sits down	NR E P- P+ +	NR E P- P+ +
4	Selects slide 2	NR E P- P+ +	NR E P- P+ +
5	Attending tap/Watches video model	NR E P- P+ +	NR E P- P+ +
6	Retrieves materials (mastered task)	NR E P- P+ +	NR E P- P+ +
7	Brings materials to work area	NR E P- P+ +	NR E P- P+ +
8	Completes mastered task	NR E P- P+ +	NR E P- P+ +
9	Selects slide 3	NR E P- P+ +	NR E P- P+ +
10	Attending tap/Watches video model	NR E P- P+ +	NR E P- P+ +
11	Walks to social partner	NR E P- P+ +	NR E P- P+ +
12	**Orients body to social partner**	NR E P- P+ +	NR E P- P+ +
13	**Emits request of attention from social partner**	NR E P- P+ +	NR E P- P+ +
14	**Emits vocal verbal label**	NR E P- P+ +	NR E P- P+ +
15	Returns materials to correct location	NR E P- P+ +	NR E P- P+ +
16	Walks to work area	NR E P- P+ +	NR E P- P+ +
17	Selects slide 4	NR E P- P+ +	NR E P- P+ +
18	Attending tap/Watches video model	NR E P- P+ +	NR E P- P+ +
19	Stands up	NR E P- P+ +	NR E P- P+ +
20	Picks up iPad	NR E P- P+ +	NR E P- P+ +
21	Brings iPad to Teacher	NR E P- P+ +	NR E P- P+ +
22	Says "All Done"	NR E P- P+ +	NR E P- P+ +
Quality Indicators			
Volume of speech		-- + ++	-- + ++
Modulation of tone		-- + ++	-- + ++
Pleasant affect		-- + ++	-- + ++
Total TA			
# of Independent Trials			
Total # of Trials			
% Independent			
Social Skill Sequence			
# of Independent Trials			
Total # of Trials		6	6
% Independent			

Appendix B: Baseline Procedural Integrity Checklist

Michigan State University

Procedural Integrity Checklist: Baseline

Researcher	
Child	
Date	
Completed by	

Component	Rating	Comments
Pre-Session Components		
Researcher ensures schedule materials are prepped	NO 1 2 3	
During Session Components		
Gains child's attention	NO 1 2 3	
Gets at eye level with child	NO 1 2 3	
Gives direct instruction to engage the chain of behavior	NO 1 2 3	
No further prompts were provided	NO 1 2 3	
Following the child performing all target behaviors correctly		
Reinforcement was withheld	NO 1 2 3	
Following no response or an incorrect response		
Reinforcement was withheld	NO 1 2 3	
Session was terminated if: 1) child didn't begin to engage in initial activity within one minute, or 2) stopped engaging in corresponding behaviors at any time for one minute	NO 1 2 3	

NO= Not Observed 1= Not implemented
2= Implemented differently than protocol 3= Implemented correctly

% of Correct Implementation:	

Appendix C: Schedule Probe Procedural Integrity Checklist

Michigan State University

Procedural Integrity Checklist: Schedule Probe

Researcher	
Child	
Date	
Completed by	

Component	Rating	Comments
Pre-Session Components		
Researcher ensures schedule materials are prepped	NO 1 2 3	
iPad with activity schedules is present on table	NO 1 2 3	
During Session Components		
Gains child's attention	NO 1 2 3	
Gets at eye level with child	NO 1 2 3	
Gives direct instruction to engage the chain of behavior	NO 1 2 3	
No further prompts were provided	NO 1 2 3	
Following the child performing all target behaviors correctly		
Reinforcement was withheld	NO 1 2 3	
Following no response or an incorrect response		
Reinforcement was withheld	NO 1 2 3	
Session was terminated if: 1) child didn't begin to engage in initial activity within one minute, or 2) stopped engaging in corresponding behaviors at any time for one minute	NO 1 2 3	

NO= Not Observed 1= Not implemented 2= Implemented differently than protocol 3= Implemented correctly

% of Correct Implementation:	

Appendix D: Intervention Procedural Integrity Checklist

Michigan State University
Procedural Integrity Checklist: Intervention

Condition (circle one): Electronic Activity Schedule Video Enhanced Activity Schedule

Researcher	
Child/Children	
Date	
Completed by	

Component	Rating	Comments
Pre-Session Components		
Researcher ensures schedule materials are prepped	NO 1 2 3	
During Session Components		
Materials are appropriately arranged	NO 1 2 3	
Unlocks iPad	NO 1 2 3	
Gains child's attention	NO 1 2 3	
Gets at eye level with child	NO 1 2 3	
Gives the verbal instruction "Go finish an activity and show a friend"	NO 1 2 3	
Hands child the unlocked iPad	NO 1 2 3	
Fades out to an independent prompt level after child takes iPad	NO 1 2 3	
Follows the system of least to most prompts	NO 1 2 3	
No social praise was used	NO 1 2 3	
If prompts were not effective, session was terminated after one minute and reinforcement is withheld	NA NO 1 2 3	

NA= Not applicable NO= Not observed 1= Not implemented
2= Implemented differently than protocol 3= Implemented correctly

% of Correct Implementation:	

Table 1: Operational Definitions and Measurement

Target Behavior	Definition	Measurement
Showing	Participant orients body towards social partner, emits a request for the attention of the social partner, and emits a vocal verbal label of something in their possession.	Task analysis of each step of behavior described in definition
Volume of speech corresponding to distance from social partner	Participant uses the appropriate volume when emitting vocal verbal behavior to social partner. Volume corresponded with participant's distance from social partner. For example, if participant is far from the social partner when speaking, a louder volume was scored as appropriate.	Likert scale: under exaggerated, appropriate, over exaggerated
Modulation in tone of voice	Participant uses an appropriate modulation in voice when emitting vocal verbal behavior. Modulation corresponded to typical inflections in vocalizations used for target vocal verbal behavior. For example, when saying the attention gaining expression "Wow! Kala!" the same or similar inflections in vocalizations as modeled in the video model was scored as appropriate	Likert scale: under exaggerated, appropriate, over exaggerated
Having a pleasant affect	Participant demonstrates positive and inviting body language when engaging in social skill with social partner.	Likert scale: under exaggerated, appropriate, over exaggerated

Table 2: Social Skill Topography Assignments

Condition	Earl	Milly	Alex	Oscar
Electronic Activity Schedule	I did my ring stacker.	Finished stacker.	I finished my puzzle.	Puzzle is done.
Video Enhanced Activity Schedule	I finished my puzzle.	Puzzle is done.	I did my ring stacker.	Finished stacker.

Table 3: Comparison of Variables Across Conditions

	Baseline	Activity Schedule Probe	Electronic Activity Schedule	Video Enhanced Activity Schedule
Discriminative Stimuli	• Explicit verbal instructions • Each step in the chain of events acts as a discriminative stimulus for the next behavior	• Explicit verbal instruction • Each step in the chain of events acts as a discriminative stimulus for the next behavior	• **"Go finish [an activity] and show a friend"** • Each step in the chain of events acts as a discriminative stimulus for the next behavior	• "Go finish [an activity] and show a friend" • Each step in the chain of events acts as a discriminative stimulus for the next behavior
Prompt	• None	• None	• **Manual guidance (Least to most)** • **Textual prompt**	• Manual guidance (Least to most) • **Video model** • **Echoic model**
Expected Behavior	• Following directions	• Following directions	• Following directions	• Following directions
Consequence If Expected Behavior Occurs	• None	• None	• None	• None
Consequence If Expected Behavior Does Not Occur	• Reinforcement withheld • Terminate session after 60 seconds of no responding	• Reinforcement withheld • Terminate session after 60 seconds of no responding	• Reinforcement withheld • Terminate session after 60 seconds of no responding	• Reinforcement withheld • Terminate session after 60 seconds of no responding

Table 4: Quality Measures and Overall Schedule Following

Participant	Session Number	Quality Measures (Number of Components Scored as Appropriate)		Overall Schedule Following	
		Electronic	Video Enhanced	Electronic	Video Enhanced
Earl	1		0		
	2	0			
	3		0		
	4	0			
	5	0			
	6		0		
	7	0			
	8		0		
	9		0		
	10	0			
	11	0			
	12		0		
	13	2		70%	
	14		2		87%
	15		2		74%
	16	3		70%	
	17		2		81%
	18	3		86%	
	19	3		80%	
	20		2		100%
Milly	1		0		
	2	0			
	3	0			
	4		0		
	5	0			
	6		0		
	7		0		
	8	0			
	9		0		
	10	0			
	13	0			
	14		0		
	17		0		
	18	0			
	19		2		71%
	20	3		76%	
	21	3		76%	
	22		3		90%
	23	3		81%	
	24		3		76%
	25		3		90%
	26	3		90%	

Table 4 (Cont'd)

	27		3		100%
	28	2		95%	
	29	3		90%	
	30		3		95%
	31		2		90%
	32	2		90%	
	33		3		100%
	34	2		95%	
	35	3		85%	
	36		3		80%
	37		3		95%
	38	3		90%	
	39		3		90%
	40	3		80%	
	41	3		95%	
	42		3		95%
Alex	1	2			
	2		3		
	3		2		
	4	2			
	5		0		
	6	0			
	7	3			
	8		3		
	9	0			
	10		3		
	11		3		
	12	3			
	13	0			
	14		0		
	17	0			
	18		0		
	21		0		
	22	0			
	25		0		
	26	0			
	27	0			
	28		0		
	29		3		64%
	30	3		68%	
	31		3		60%
	32	3		70%	
	33	3		85%	
	34		3		75%

Table 4 (Cont'd)

Oscar	1		0		
	2	0			
	3		0		
	4	0			
	5	0			
	6		0		
	7		0		
	8	0			
	9		0		
	10	0			
	15	0			
	16		0		
	19		0		
	20	0			
	25	0			
	26		0		
	31	0			
	32		0		
	33		0		
	34	0			
	35	3		75%	
	36		3		55%
	37	3		80%	
	38		3		60%
	39		3		76%
	40	3		81%	
	41	3		90%	
	42		3		71%
	43	3		90%	
	44		3		81%
	45		3		86%
	46	2		81%	
	47		3		86%
	48	2		95%	
	49	3		85%	
	50		3		90%

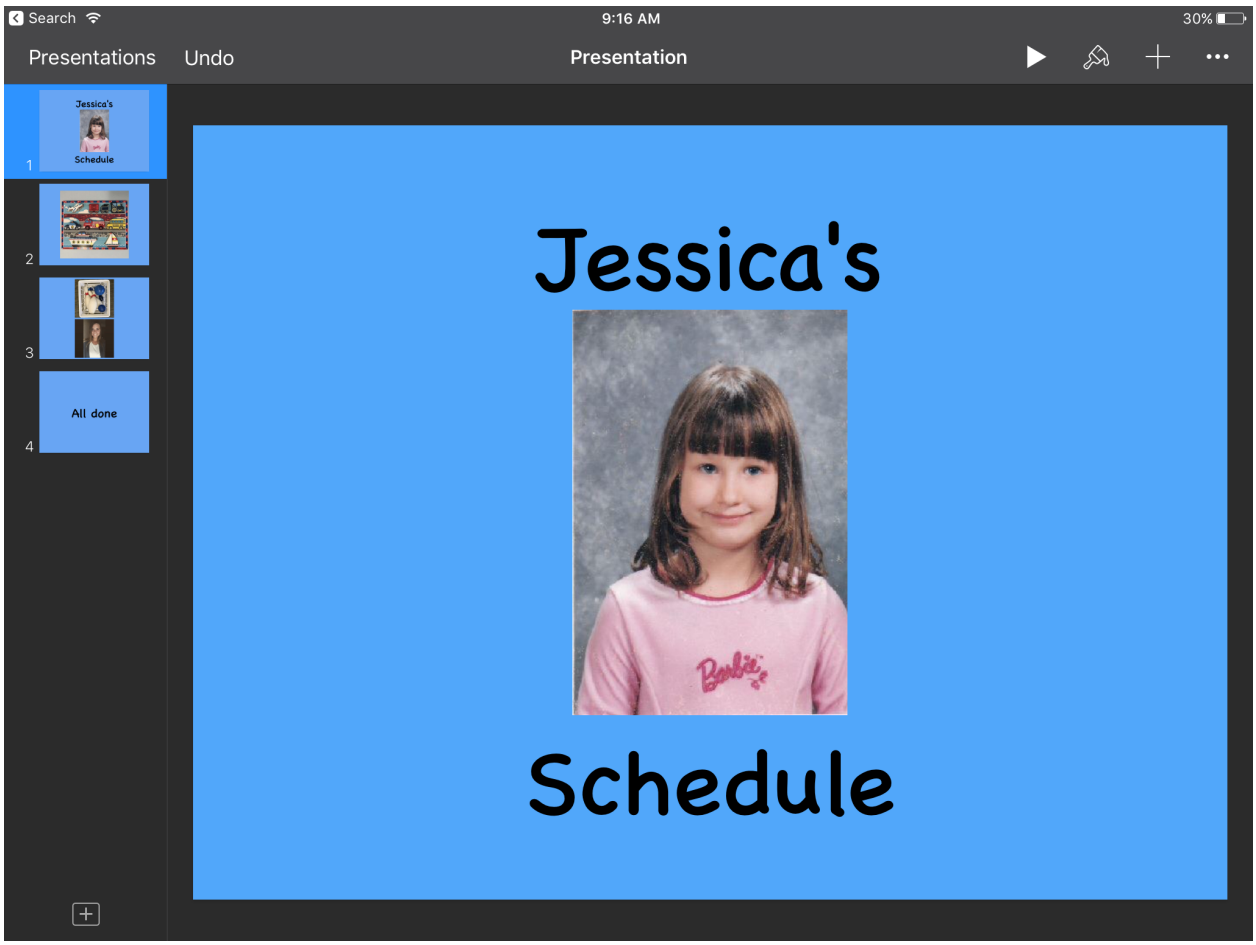

Figure 1: An example of what an electronic activity schedule looked like in the Apple® Keynote® iPad application

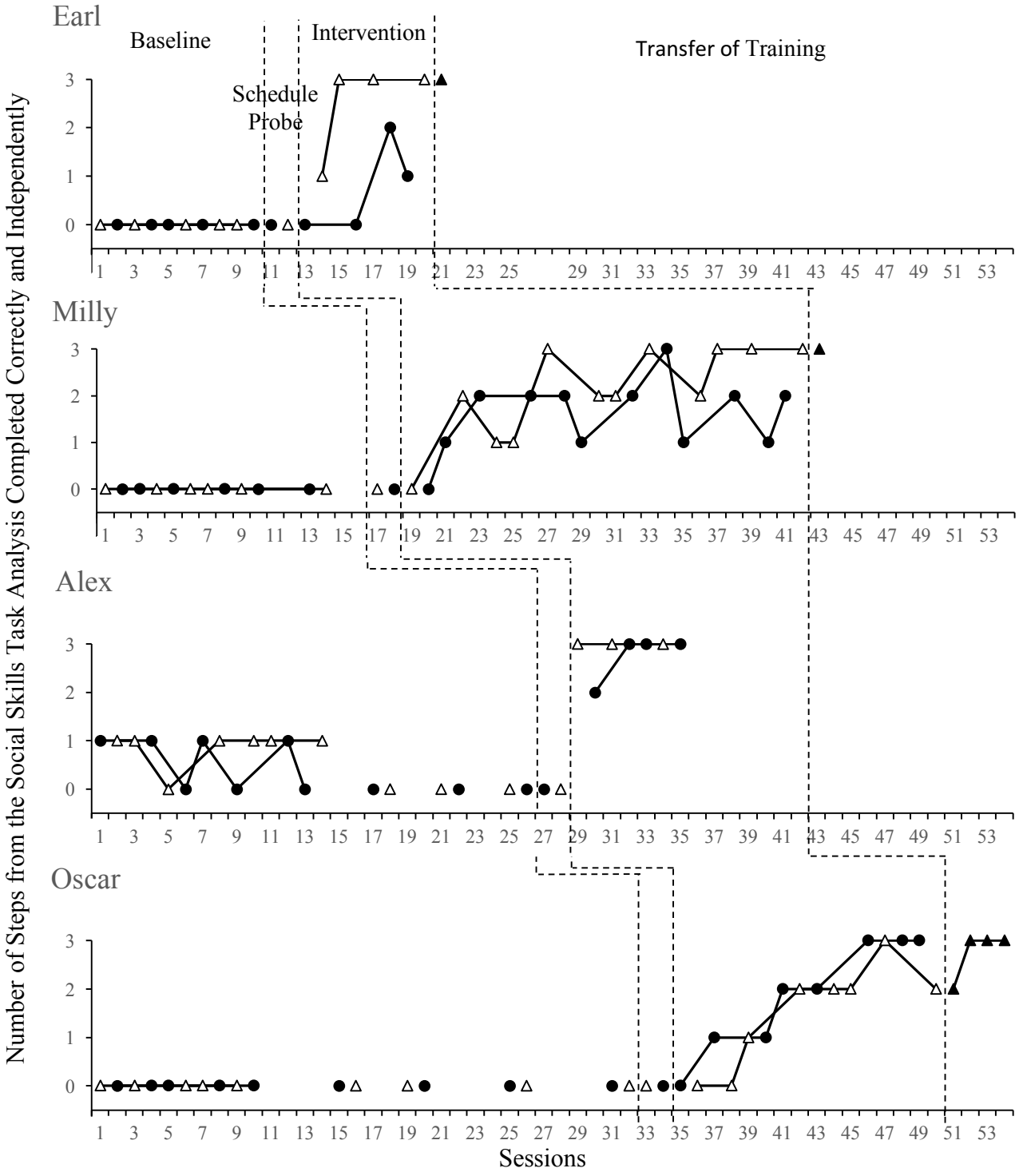

Figure 2: Results for Earl, Milly, Alex, and Oscar. Closed circles denote electronic activity schedule condition, open triangle denote the video enhanced activity schedule condition, and closed triangles denote the transfer of training condition.

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