ABSTRACT

Video Activity Schedules to Support Academic Learning
for Children with Autism Spectrum Disorder

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Individuals with autism spectrum disorder (ASD) have deficits in communication and engage in restrictive and repetitive behaviors that may impede their ability to learn, particularly in school environments. Evidence-based practices such as visual supports and video modeling have been used to support individuals with ASD. Activity schedules, a type of visual support and video modeling have both demonstrated effectiveness across a variety of skills and settings. However, less is known about what skills or contexts are appropriate for combining the two interventions, known as a video activity schedule.

A systematic review was conducted to understand the current research regarding video activity schedules to support skill acquisition (i.e., learning) for individuals with ASD. The results of the review and areas for future research can be found in Chapter Two. Based on the results, a limited number of studies evaluated use of video activity schedules to support academic tasks in general education classrooms. Furthermore, no studies evaluated its use with peers. Therefore, research in this area seems warranted. Chapter Three describes an experimental study that evaluates use of video activity

schedules to complete math center activities with young children with ASD and typically developing peers, including one participant in a general education classroom. Chapter Four contains the results of the experimental study, and Chapter Five provides a discussion of the results noting areas for future research. Overall, video activity schedules improved activity completion and on-task behavior for children with ASD and their peers during academic learning activities, but some concerns may need to be considered before using them. Additional research in this area is warranted.

Video Activity Schedules to Support Academic Learning for Children with Autism Spectrum Disorder

by

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A Dissertation

Approved by the Department of Educational Psychology

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Grant Morgan, Ph.D., Chairperson

Submitted to the Graduate Faculty of
Baylor University in Partial Fulfillment of the
Requirements for the Degree
of

Doctor of Philosophy

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August 2021

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ACKNOWLEDGMENTS

I would like to thank my advisor and mentor, Dr. Jessica Akers, for guiding me over the last four years. Her confidence in me has always been unwavering. It is because of her mentorship and support that I feel ready for the next chapter of my life in academia. Thank you to the other members of my dissertation committee- Drs. Tonya Davis, Tracey Sulak, Joyce Nuner, and Katie Ledbetter-Cho. I am grateful for their time, advice, and feedback throughout each stage of this process.

A big thank you to my lab mates, Nicole O'Guinn, Suzy Avery, and Remi Swensson for their help with data collection and for being my cheerleaders throughout this process. I am deeply grateful for my fellow doctoral program colleagues who have supported and collaborated with me over the years, especially David Rehfeld, Supriya Radhakrishnan, & Gabby Rivera.

I am forever grateful for my family who sacrificed so much for me to be able to pursue my graduate school dreams. My husband, Sean, has provided unconditional love and support through such trying times, and I cannot thank him enough. I am blessed to have had the support of my parents, siblings, and grandparents, all of whom have rooted for my quest for knowledge and ambition, especially my Gramps who I miss and love dearly.

Finally, I'd like to thank Organization for Autism Research (OAR) for awarding me a graduate student grant to conduct my experimental study.

DEDICATION

To my daughter, Averie Grace Kirkpatrick

CHAPTER ONE

Introduction

Currently, 1 in 54 children are diagnosed with autism spectrum disorder (ASD) with boys being four times more likely to be affected with ASD than girls (Maenner et al., 2020). ASD is a neurological developmental disorder that affects the individual's ability to understand social situations, communication, and behavioral differences. The two diagnostic criteria for ASD include impairments in social communication and restrictive and repetitive behaviors, interests, or activities (American Psychiatric Association, 2013). The use of the word "spectrum" within ASD refers to the diverse way in which these criteria may present for each individual with ASD. Social communication impairments range from limited vocal communication with others (e.g., nonverbal communicator) to deficits in pragmatic language, such as the inability to understand sarcasm or jokes. Individuals with ASD may engage in repetitive behaviors like hand flapping or spinning their body, have intense interests in specific topics or items (e.g., trains) that occupy much of their time (e.g., conversing about the interest), or engage in ritualistic routines such as turning off the lights five times before leaving a room. Cognitive or intellectual ability for children with ASD varies. Approximately 44% of children with ASD have intellectual ability ranging from average to above average (Maenner et al., 2020). Learning may be challenging due to their deficits in social and language or communication skills. For example, it may take longer for a student with ASD to respond appropriately to verbal instructions than their typically developing peers, or they may have limited focus and attention making tasks or assignments longer to complete. It is therefore imperative that practitioners use evidence-based practices with individuals with ASD.

Evidence-based practices refer to interventions or teaching methods that are based on high-quality research that has demonstrated the intervention or teaching method to be effective in improving outcomes for learners across multiple research studies (Cook & Cook, 2013). Currently, there is no cure for ASD; however, early identification and effective intervention improve lifelong outcomes for individuals with ASD. Within the context of education, both the Individuals with Disabilities Education Act (IDEA; 2004) and Every Student Succeeds Act (2015) mandate the use of evidence-based or research-based practices in the classroom. The most frequently used and empirically validated interventions for individuals with ASD are those aligned with the principles of Applied Behavior Analysis (ABA; Reichow, 2012). ABA is the science of behavior in which environmental factors are manipulated in order to alter an individual's behavior. Specifically, ABA is the application of principles established from the experimental analysis of behavior to target socially significant behavior such as teaching important skills to individuals with ASD. Applications of ABA involve data collection and analysis of observable and measurable occurrences of behavior. Further, employed interventions for behavior change must be based on the principles and concepts of behavior analysis, use clearly defined protocols and procedures that others may be able to understand and in turn implement, be continuously monitored to ensure effectiveness, and provide opportunity for the behavior to be evaluated in contexts outside of which they were intervened upon (Baer et al., 1968; Cooper et al. 2007). Behavior analytic interventions are used for individuals with ASD both to acquire new skills like communication or play and decrease undesirable behaviors like aggression towards others. Examples of evidence-based practices aligned with ABA to facilitate learning for individuals with ASD include behavioral momentum, discrete trial teaching (DTT), functional communication training, and task analysis, to name a few (Steinbrenner et al., 2020). Prompting and reinforcement, both identified as evidence-based practices, are often used alongside these instructional methods to promote skill acquisition.

A fundamental concept of ABA is the three-term contingency. First, a discriminative stimulus evokes a behavior. A discriminative stimulus refers to environmental stimuli for which there is a history of reinforcement that would signal to the learner that engaging in the behavior will contact reinforcement. Following the occurrence of the behavior, a consequence will determine if that behavior is likely to occur, as is the case for reinforcement, or not occur again, as is the case for punishment (Cooper et al., 2007). For example, when a stoplight turns red (discriminative stimulus), the brake pedal is pushed (behavior), and the car stops thereby ensuring the driver avoids an accident or ticket (reinforcement). When the discriminative stimulus does not evoke the behavior, particularly if the learner has no previous learning history, prompting can be used to occasion the behavior. Prompting is used to ensure a correct response is made in the presence of the discriminative stimulus that will ultimately occasion the behavior. Prompts can be categorized as either response prompts or stimulus prompts. Response prompts are delivered following the discriminative stimulus and prior to the performance of the behavior such as verbal instructions, modeling the expected behavior, or providing physical guidance (Cooper et al., 2007). For example, a teacher using DTT to teach letter identification may provide a physical prompt (i.e., guiding the student's hand to the correct letter) after saying, "Point to the letter 'B", to ensure an immediate correct response. Stimulus prompts are delivered with the discriminative stimulus and prior to the learner engaging in the target behavior using the relevant stimuli (Cooper et al., 2007). For example, when laying out the array of letter cards, the teacher may situate the 'B' card closer to the learner prior to saying "Point to the letter B".

It is important for the instructor to consider what types of prompts are appropriate for the skill and develop prompt fading strategies, so the behavior comes under the control of the discriminative stimulus (e.g., alphabet letter), rather than the prompt. Prompt dependency refers to the learner failing to engage in the target response until a prompt is delivered, even if the skill has already been acquired (Oppenheimer et al., 1993). Using prompt fading strategies can reduce prompt dependency. Prompt fading refers to a gradual elimination of the prompts that control the behavior until responding is occurring in the presence of the discriminative stimulus without the use of prompts. Examples of prompt fading include prompt hierarchies, gradual guidance, and time delay. Prompt hierarchies note the most intrusive (e.g., full physical prompt) to least intrusive prompts (e.g., stimulus prompt), or vice versa, where the instructor decreases or increases the level of prompting based on the learner's behavior. For example, a parent tells a child to pick up their toys. When the child fails to do so, they may provide the verbal prompt "put your toys in the toy box", then model putting a doll in the toy box, then place their hand at the child's elbow to guide the child's hand towards picking up a toy to place in the toy box, then provide hand over hand assistance to do so. Graduated guidance systematically reduces the amount of physical prompting over time. For example, a teacher may provide a student with a full physical prompt by providing hand overhand guidance to write their name, then move to a partial physical prompt by touching the elbow of the student, and then to the shoulder of the student. Time delay incorporates intervals of time (i.e., delay) between the discriminative stimulus and providing the response prompt. For example, a parent may tell their child to put on their shoes and then wait for about five seconds before providing a physical prompt to help their child put one shoe on their foot. While prompting can be essential to facilitate learning, procedures for using prompt fading should be considered in order to reduce the number of resources (e.g., instructor time) required to be disposed by other humans. Prompts delivered by others are generally considered to be more intrusive and can be gradually faded to stimulus prompts within the environment. For example, if a parent previously provided verbal prompts to their child to wake up for school, this can be supplemented by setting an alarm. These stimulus prompts tend to be more common within our environment and promote a level of independence such as writing down a doctor's appointment on a calendar to serve as a reminder. Two evidence-based practices for individuals with ASD that serve as types of stimulus prompts are visual supports and video modeling.

Visual supports are concrete representations (e.g., pictures, text) that present cues about a routine, activity, or expected skills or behaviors and have been used to support social skills, communication, play, academic skills, adaptive or daily living skills, and vocational skills from preschool aged children to adults (Steinbrenner et al., 2020). Examples of visual supports include graphic organizers, visual prompts, scripts, and activity schedules. Graphic organizers combine text and pictures to show relationships between concepts or sequence ideas. Visual prompts are pictures that provide the learner with a cue such as a picture of a backpack being placed next to hooks in a classroom. Scripts are represented by text that provide the learner with dialogue to use. Activity schedules refer to a series of pictures, images, or drawings that represent a sequence of events that prepare the learner for the next activity or step within an activity (Knight et al., 2015). Research has demonstrated that activity schedules can be used to improve social play (Akers et al., 2018), transitions (Pierce et al., 2013), and task engagement (Zimmerman et al., 2017), as well as reduce problem behavior (Lequia et al., 2012). They are traditionally presented in a three-ring binder with one page for each picture of the activity or using hook and loop strips along a binder or poster material (Hume & Odom, 2007; MacDuff et al., 1993). However, advances in technology over the last ten years have made it possible to use activity schedules outside of traditional pictures or images and three-ringed binders to digital pictures on handheld devices, which are referred to as digital activity schedules.

A growing body of literature has evaluated the use of digital activity schedules to teach individuals with ASD or intellectual disabilities. Digital activity schedules employ programs like Google Slides™ or Microsoft PowerPoint™ to display digital pictures of expected activities or reinforcers, text, and in some cases a timer on each slide. Users navigate the digital activity schedule by using their finger to swipe to the next slide rather than turning a page (Reinert et al., 2020). Like traditional activity schedules, research has demonstrated that digital activity schedules on portable devices can be used to increase on-task behavior (Carlile et al., 2013), completion of leisure activities (Giles & Markham, 2017), and increase independence for the user. Additionally, digital activity schedules offer a number of benefits, relative to traditional activity schedules. Because pictures can be taken on the device or saved from the internet on the device, those creating the schedules do not have to use multiple pieces of equipment (e.g., computer, printer, and laminator) to create an activity schedule, which enhances its ease of use. The schedules can also be shared with others through shared folders or files (e.g., Google Drive™). Digital activity schedules on tablets and smartphones are also more portable and presumably less stigmatizing than the three-ring binders as it is not uncommon for individuals to use such devices throughout their day. Finally, while the initial cost of these devices can be expensive (e.g., the average price for a tablet in the United States is about $260; Statista Research Department, 2020), they may be more cost efficient over time as the need to print, laminate, and purchase materials like hook and loop are eliminated (Reinert et al., 2020).

Video modeling provides a video-recorded example of the expected target behavior for the individual to perform. The learner watches the video in its entirety and is then given the opportunity to perform the target behavior (Charlop-Christy et al., 2000; Steinbrenner et al., 2020). A benefit to video modeling is that it aids the learner in attending to the relevant stimuli needed to complete the task. Video modeling has been demonstrated to be effective in teaching social and communication skills, play skills, adaptive or daily living skills, vocational skills, and academic skills from preschool aged children to adults. Additionally, evidence has suggested that various models within the video (e.g., adults, peers, the learner) are all equally effective (Hong et al., 2017; Steinbrenner et al., 2020). Earlier studies evaluating the effects of video modeling used video cameras, videotapes, VCRs, and televisions (e.g., Buggey, et al., 1999; Charlop & Milstein, 1989); however, currently, video models are often created using a smartphone or tablet and displayed on the same device. Despite the positive effects of using video modeling, limitations to traditional video modeling include the learner's ability to attend to the video, particularly if the video is longer in length, as well as the learner's ability to perform the target behavior following the video if it's more complex (Wertalik & Kubina, 2018).

Recent research has evaluated the efficacy of combining digital activity schedules and video modeling, an intervention referred to as *video activity schedules*. Video activity schedules are designed similarly to a digital activity schedule; however, video models replace the traditional static pictures for each task within the schedule (Spriggs et al., 2015). Video activity schedules differ from video modeling in that the video models embedded within the activity schedule are often shorter in duration and include multiple video models sequenced to break down more complex activities. The same prompting procedures (e.g., most-to-least) used to teach learners how to use a traditional activity schedule are used to teach a video activity schedule, including locating the device, using the schedule to complete activities, and returning the device. With visual supports (i.e., activity schedules) and video modeling being evidence-based practices for teaching individuals with ASD, it is important to understand under what conditions video activity schedules can be used to teach, and support individuals diagnosed with ASD.

CHAPTER TWO

Literature Review

As indicated in the previous chapter, video activity schedules are a hybrid between video modeling and visual activity schedules in that the static pictures within an activity schedule are replaced with video models. For the purpose of this literature review, the term video activity schedule refers to a series of video models depicting a sequence of steps required for completing one or multiple tasks. Studies were included based on this definition rather than based on designations made by the authors of each study. For example, many authors described the intervention as video prompting, and these studies were included as they met the definition of video activity schedules. Increased interest in video-based instruction and technology has led to a robust body of research and evaluation via systematic reviews and meta-analyses. Specifically, within the last five years, two systematic reviews and one meta-analysis have been conducted on use of video modeling and video prompting interventions for individuals with disabilities.

Bennett et al. (2017) conducted a systematic review on video-based instruction which focused on video modeling interventions, including video self-modeling and video prompting, for individuals with ASD, intellectual disabilities, or developmental disabilities. However, this review specifically focused on comparison studies that compared components of the intervention (e.g., video modeling with an adult model versus a peer model). While this review provides researchers and practitioners with valuable information on the use of certain components relating to video modeling, it is limited to comparative studies and does not capture all the video activity schedule literature. Similarly, Park et al. (2019) systematically reviewed the existing literature on video modeling and video prompting interventions with individuals with intellectual disabilities. Overall, their findings indicate that daily living skills were targeted most often, and all of the studies had medium or large effects based on single-case research design effect sizes. Despite the positive outcomes of this review, it is limited to individuals with an intellectual disability, who may have differing needs than individuals with ASD. Finally, a meta-analysis conducted by Aljehany and Bennett (2019) focused solely on video prompting to teach daily living skills to individuals with ASD, including those with an intellectual disability. Moderate effect sizes were found overall with large effect sizes reported for elementary and adult age participants and for participants with ASD only. While this review addresses the ASD population, it is limited to daily living skills and video prompting. Thus, it does not provide information on other types of skills that can be taught, nor does it encompass the broad literature on all video activity schedules.

Overall, additional information regarding all areas of skill acquisition, not just daily living skills, for individuals with ASD seems warranted. The purpose of this literature review was to synthesize the current literature regarding use of video activity schedules for individuals with ASD and identify areas for future research.

Method

Inclusion Criteria and Database Search

Articles were included within the review if they met the following criteria (a) an experimental design was used to evaluate the effects of a video activity schedule, (b) a video activity schedule (i.e., a series of video models depicting a sequence of steps required for completing one or multiple tasks) served as the primary intervention, and (c) included one or more participants with ASD. An experimental study is one in which the researcher or experimenter is solely responsible for systematically manipulating the conditions or phases of the study. Therefore, literature reviews, meta-analyses, tutorials, or discussion papers were not included. Participants with an ASD diagnosis, as reported by the authors, met the inclusion criteria. This included participants identified with autism, ASD, Autistic Disorder, Asperger's Disorder, or Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS).

To begin, the primary researcher conducted a database search using the databases Academic Search Complete, APA PsycINFO, and ERIC. These databases were selected as they include indexing from journals hypothesized to include research related to teaching skills to individuals with ASD. The keywords used for the search were meant to capture studies that included individuals with ASD and video activity schedules. The keywords were combined to identify articles that included both the population and intervention. The keywords used to describe individuals with ASD were autis*, autism spectrum disorder, and ASD. The keywords used to describe video activity schedules were video activity schedule, activity schedule, and video prompting. The search was limited to English, peer-reviewed articles. This resulted in 375 articles, 192 with duplicates removed.

Search Process

The titles and abstracts of all 192 articles were screened using the inclusion and exclusion criteria. After this screening, 73 articles advanced to a full-text review and 119 were discarded. Following the full-text review, 53 articles were included in the review and 20 articles were discarded.

The next step in the search process were the ancillary searches. First, backward and forward searches were conducted. For the backward search, the references of the included articles were reviewed for titles that may indicate the use of a video activity schedules. This resulted in seven additional articles being included. The forward search employed Google Scholar to identify articles that cited those that were included. This resulted in 10 additional articles being included. Next, a hand search of the last three years (i.e., August 2017 – August 2020) of *Journal of Autism and Developmental Disorders* was conducted because this journal had published many of the identified articles. *Journal of Autism and Developmental Disorders* publishes issues for each volume monthly rather than quarterly like most peer-reviewed journals. Therefore, it was decided that three years would produce a sufficient number of journal articles to search through. No additional articles were identified. Finally, the publications of Helen I. Cannella-Malone and Linda C. Mechling were examined as they were the first author on many of the identified articles. Two additional articles were included. At the conclusion of these ancillary searches, a total of 72 articles were included in the final review.

Descriptive Information

The following information was extracted from the articles: (a) participant information, (b) the skill targeted for acquisition (i.e., dependent variable) and method used to measure the dependent variable, and (c) independent variable information. Participant information included age, sex, and reported disability or diagnosis. Independent variable information included the setting, the implementer, the technological device used for video activity schedules, whether the intervention was applied to a single task or multiple tasks, the number of steps in the task analysis developed for the task, the number of video model segments in the schedule, and the duration of the video model segments. Video model segments refer to both a video model that depicts an entire activity from beginning to end, and a video clip that depicts individual steps within an activity.

Interrater Reliability

Database search and article review agreement. A secondary researcher independently conducted the search to determine if the same articles were identified to assess interrater reliability (IRR). The secondary researcher recorded the total number of articles identified. Agreement was calculated by dividing the smaller number by the larger number and multiplying by 100. This resulted in 100% agreement. After screening for articles, 73 articles were included for a full-text review. A secondary researcher reviewed 25 of the 73 articles (34%) against the inclusion and exclusion criteria. They recorded the number of articles that met inclusion criteria. Agreement was calculated by dividing the number of agreements plus disagreements and multiplying by 100. Agreement for inclusion in this review was 100%.

Descriptive coding agreement. IRR was measured for data extraction. Prior to extracting descriptive information from the articles, two secondary researchers were trained on the coding sheet by the primary researcher. The training consisted of reviewing the coding sheet with discussion on each variable and operational definitions until the secondary researchers could verbally state how an example article would be coded. For example, if the skill taught in the article was washing dishes, the secondary researchers stated they would mark the column labeled "daily living skills". Next, both the primary researcher and both secondary researchers independently coded the same two articles and then met to discuss their results. A minimum agreement of 80% was expected before coding the remaining articles could occur. Between the primary and secondary researchers, the average agreement was 85%. Disagreements were resolved with discussion.

After the training was complete, the primary researcher extracted data from all the articles to code for descriptive information, while the two secondary researchers independently extracted data from 13 articles each, for a total of 26 articles (35%). The average agreement between the primary and secondary coders was 93% (range 77 to 100%). Disagreements between the primary and secondary researchers were resolved with discussion until agreement was met.

Results

Based on the eligibility criteria, a total of 72 articles (i.e., 72 studies) were included in this review. These articles were published between the years 2004 to 2020 in 28 peer-reviewed journals.

Participant Information

The total number of participants across all the included studies was 182 (see Table 1). Of the 182 participants, 144 were male (80%) and 32 were female (17%). Sex was not reported for six participants (3%). All the participants' ages were reported. Two participants were under the age of three (1%), six participants were three to five years old (3%), 35 participants were six to 11 years old (19%), 119 participants were 12 to 21 years old (65%), and 20 participants were 22 years or older (11%). All participants had an ASD diagnosis due to the eligibility criteria. Comorbidity, the presence of more than one disability or diagnosis, was identified for 90 participants (49%). Of these 90 participants, 65 had an intellectual disability (72%), 11 had a speech impairment (12%), 10 had another type of developmental disability other than ASD (i.e., Fragile X syndrome, Williams syndrome, Down syndrome, chromosomal microdeletion syndrome, and developmental delay; 11%), eight had attention-deficit/hyperactivity disorder (ADHD; 8%), and five had epilepsy or a seizure disorder (6%). Less common diagnoses or disorders included hearing loss (n = 3), cephalic disorders (n = 2), bipolar disorder (n = 2), obsessive compulsive disorder (n = 2), cystic fibrosis (n = 1), sensory processing disorder (n = 1), mood disorder (n = 1), anxiety disorder (n = 1), and schizophrenia (n = 1).

Table 1

Participant Information

Variable	Number of participants	Percentage of participants
Gender		
Male	147	80%
Female	32	17%
Not reported	6	3%
Age		
Under 3 years old	2	1%
3 to 5 years old	6	3%
6 to 11 years old	35	19%
12 to 21 years old	119	65%
22 years and older	20	11%
Not reported	0	0%
Disability or diagnosis		
Intellectual disability	65	36%
Developmental disability	9	5%
Speech impairment	11	6%
ADHD	8	4%
Other	17	9%
Target skill		
Academic	31	17%
Daily living or adaptive	90	49%
Vocational	33	18%
Leisure or play	29	16%
Other	8	4%

Note. ASD autism spectrum disorder; ADHD attention deficit hyperactivity disorder

The skills targeted for intervention were reported in all the studies. Of the 182 participants, 90 had a daily living or adaptive skill targeted (49%). This included activities or tasks such as doing laundry, folding clothes, preparing or cooking a meal or snack, cleaning (e.g., sweeping, washing dishes), setting the table for a meal, tying shoes, and eating meals appropriately. Vocational skills were targeted for 33 participants (18%). This included activities or tasks such as clerical work (e.g., sending a fax, photocopying), packing backpacks with items to be delivered, cleaning and shelving items at a store, gardening tasks, data entry into a spreadsheet, cleaning and preparing a conference room for business meetings, and checking in and shelving books at a library. Academic skills were targeted for 31 participants (17%). This included content in the areas of math (e.g., solving addition problems; Dueker & Canella-Malone, 2019), science (e.g., identifying animal habitats; Knight et al., 2018), social studies (e.g., identifying locations on a map; Knight et al., 2018), writing (e.g., spelling; Knight et al., 2018), reading (e.g., reading comprehension; Sartini et al., 2020), and engineering (e.g., coding robots; Wright et al., 2019). Leisure or play skills were targeted for 29 participants (16%). This included activities or tasks such as drawing, playing with toys (e.g., toy sets, Legos®, Mr. Potato Head™, Lite Brite™), making arts and crafts, photography, exercise (e.g., yoga, jumping jacks), aquatics, painting fingernails, playing dominoes, and throwing darts. Transitioning from one activity to another within the school day was targeted for four participants (2%) and using text messages to communication requests to others was targeted for four participants (2%).

Setting, Implementer, Technology Devices, and Generalization

The setting in which the study took place was identified in all the studies (see Table 2). Of the 72 studies, 68 reported a single setting (94%) and four reported multiple settings (6%). Fifty-one studies were conducted in a school (71%), 10 studies were conducted in a workplace (i.e., office, copy room, break room, pet store, library, garden center, vocational training center; 14%), five studies were conducted in the participant's home (7%), five studies were conducted at a clinic or center (7%), three studies were conducted in the community (i.e., grocery store, swimming pool; 4%), two studies were conducted at an apartment rented by the school (3%), and one study was conducted at a residential care facility (1%). Of the 51 studies in which sessions were conducted in a school setting, 40 occurred in a special education classroom or a school designated for students with disabilities (78%), 13 studies occurred in another classroom or area of the school that was not the participants' primary classroom (26%), one study occurred in a general education classroom (2%), and one study did not specify the classroom (2%). Four of the 51 studies occurred in multiple locations within the school (8%).

The implementer was identified for 71 of the 72 included studies. Of the 71 studies, 67 studies had a single implementer (94%) while four had multiple implementers (6%). In 70 studies, a researcher implemented all or some of the procedures (99%), a teacher implemented the procedures in 12 studies (17%), and a parent implemented the procedures in a single study (1%). A paraprofessional implemented the procedures in two studies (3%), a job coach implemented the procedures in one study (1%), a therapist implemented the procedures in one study (1%), and graduate student instructors implemented the procedures in one study (1%).

All the studies reported the type of device that was used to display the video activity schedules. A tablet (e.g., iPad®) was used in 36 studies (50%), a computer was used in 17 studies (24%), an iPod touch® was used in 11 studies (15%), a smartphone was used in five studies (7%), a personal digital assistant (PDA) was used in four studies, and a portable DVD player was used in one study (1%). Two studies included more than one device which is why the total is greater than 72.

Of the 72 studies, 29 included a measure of generalization for all or some of the participants. This included 20 studies in which researchers assessed generalization to novel stimuli (69%), 10 studies in which researchers assessed generalization to a new setting (34%), and seven studies in which researchers assessed generalization to a different person (24%).

Measurement of the Dependent Variable

The method used to measure the dependent variable was collected from all the studies (see Table 2). Multiple measures were reported in 27 of the 72 studies (38%). For 65 of the studies, researchers collected data on the percentage of steps completed correctly for each task or across multiple tasks (90%). In seven of the studies, researchers collected data on the number of sessions required for the participant to reach mastery criteria (10%). For six of the studies, researchers collected data on the percentage of steps completed correctly using the technology device (e.g., opening the application, selecting the video activity schedule, pressing play; 8%). This was collected separately from the previously mentioned steps or activities completed correctly. However, it is likely that some of the 65 studies from the first category collected these data within the task analysis they used to collect data without specifically stating that they did so (e.g., press play and swipe to the next video model were included in the task analysis). In six of the studies, researchers collected data on the level of prompt required for the participant to complete the step or activity (8%). For five of the studies, researchers collected data on the number of prompts required to complete a step (7%). For three of the studies, researchers collected data on the percentage of intervals with on-task or on-schedule behavior (4%). This was defined individually by the authors of the study but often included independent and correct engagement with the activity materials, orienting towards the materials or technology, and transitioning appropriately from one activity to the next. In three of the studies, researchers collected data on the total duration of completing the activity or task (4%). For three of the studies, researchers collected data on the frequency or percentage of intervals with challenging behavior (4%). Two studies collected data on the percentage of independent transitions (3%). Two studies collected data on the frequency or percentage of correct responses on the activity (e.g., math problems; 3%). The following data were collected from one study each: frequency of social initiations made, percentage of steps requiring an error correction procedure, percentage of say-do play responses, total instructional time for mastery criteria to be met, and frequency of errors made.

Table 2

Study Features

Variable	Number of studies	Percentage of studies
Setting		
School	51	71%
Special education	40	78%
General education	1	2%
Other classroom/area	13	26
Not specified	1	2%
Home	5	7%
Workplace	9	13%
Community	2	3%
Other	10	14%
Implementer		
Researcher	63	88%
Teacher	12	17%
Parent	1	1%
Other	15	21%
Not reported	1	1%
Device		
iPad or tablet	36	50%
Smart phone	5	7%
Computer	17	24
iPod Touch	11	15%
Other	4	6%
Measurement of dependent variable		
Task or steps completed correctly	65	90%
On-schedule or on-task	3	4%
Navigation of the technology	6	8%
Other	24	33%

Video Activity Schedules Information

While there were 182 participants included across all studies, a total of 306 unique cases were reported and individually coded for this portion of the review. A case was defined as a single application of the intervention in which performance was measured. This included a single participant within the study who had the intervention applied to more than one individual skill (e.g., sweeping and making popcorn). For example, in Canella-Malone et al. (2018), the participant named Peter had three skills included in the study (i.e., making lemonade, folding a shirt, and loading the dishwasher), and each of these were considered a case. This also applied to multiple participants within the study who were all learning the same skill (e.g., table washing) for which the intervention was individually applied. For example, in Gardner & Wolfe (2019), all four participants learned how to wash dishes, and each application (i.e., each participant using the video activity schedule to learn how to wash dishes) was considered a case.

The number of steps to complete a single task or multiple tasks within the video activity schedule were coded for each case. An individual task like making popcorn could comprise of 11 steps. However, doing the laundry includes at least two individual tasks with varying numbers of steps. Washing clothes may comprise of 10 steps, while drying clothes may comprise of six steps. Out of the 306 total cases, 264 reported the number of steps required to complete one task or multiple tasks (86%). Of these 264 cases, 118 cases required two to 10 steps (45%), 108 cases required 11-20 steps (41%), 24 cases required 21-30 steps, and 14 cases required 31 or more steps (5%). Out of the 306 cases, 281 cases had a single activity included in their schedule (92%), and 25 cases (i.e., 25 participants) had multiple activities included in their schedule (8%). Of these 25 cases with multiple activities, nine cases had three activities (36%), six cases had 10 activities (24%), four cases had five activities (16%), three cases had four activities (12%), and three cases had nine activities (12%).

The number of video model segments included in the video activity schedule were reported for 277 cases (91%; see Figure 1). Of the 277 cases, the total number of video model segments were reported for 272 cases (98%) and the range of the number of video model segments were reported for five cases (i.e., 10-13 video model segments; 2%). Of the 272 cases with the total number reported, 131 cases included schedules with three to 10 video model segments (48%), 109 cases included schedules with 11-20 video model segments (40%), 25 cases included schedules with 21-30 video model segments (9%), and nine cases included schedules with 31 or more video model segments (3%).

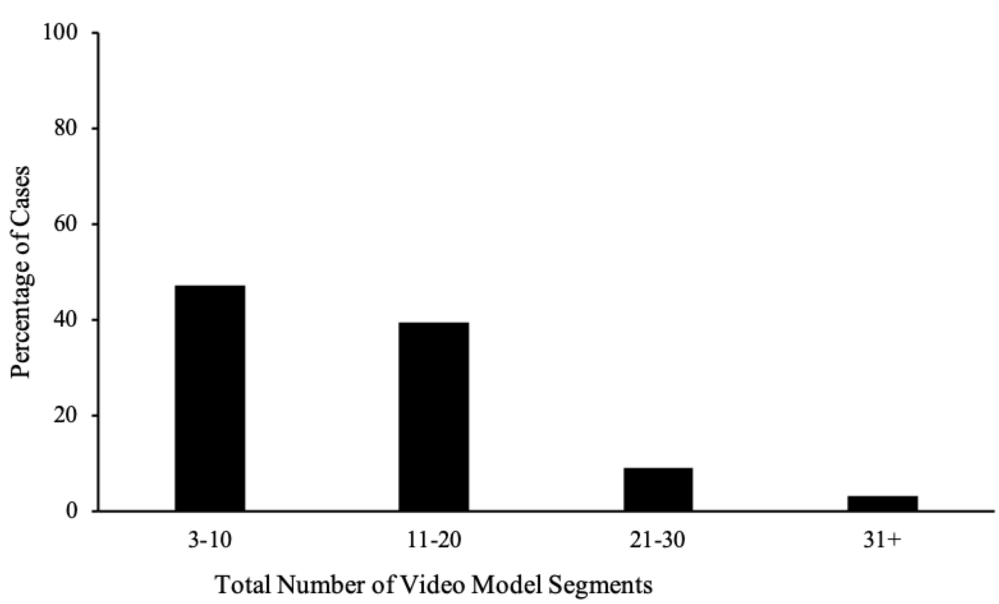

Figure 1. The percentage of cases (n = 277) that reported the total number of video model segments for each category.

In addition to the number of video model segments, the duration was also recorded. Out of the 306 cases, duration was reported for 189 (62%). Authors employed three strategies to present information related to the duration of the video model segments: (a) total duration, (b) average duration, and (c) range. Of the 189 cases for which the duration was reported, the total duration was reported for 69 cases (37%; see Figure 2). Of the 69 cases, 13 cases had a total duration of less than 30 seconds (19%), 12 cases had 31-60 seconds (17%), 14 cases had 61-120 seconds (20%), and 30 cases had

121 or more seconds (44%). Of the 189 cases for which the duration was reported, the average duration was reported for 50 cases (37%; see Figure 3). Of these 50 cases, 19 cases had an average duration of less than 10 seconds (38%), 27 cases had 11-30 seconds (54%), and four cases had 30 or more seconds (8%).

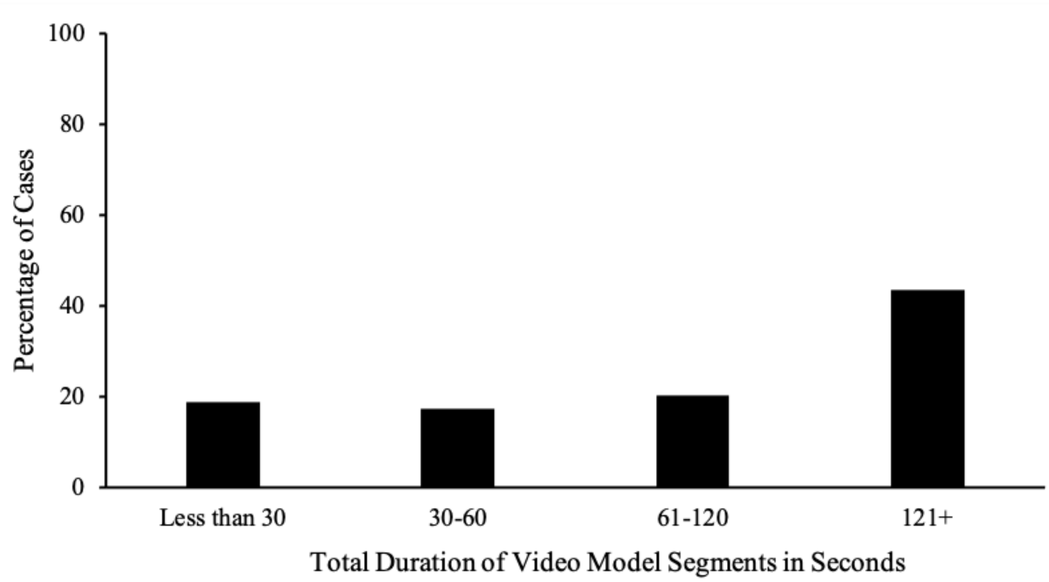

Figure 2. The percentage of cases (n = 69) that reported the total duration of video model segments (in seconds) for each category.

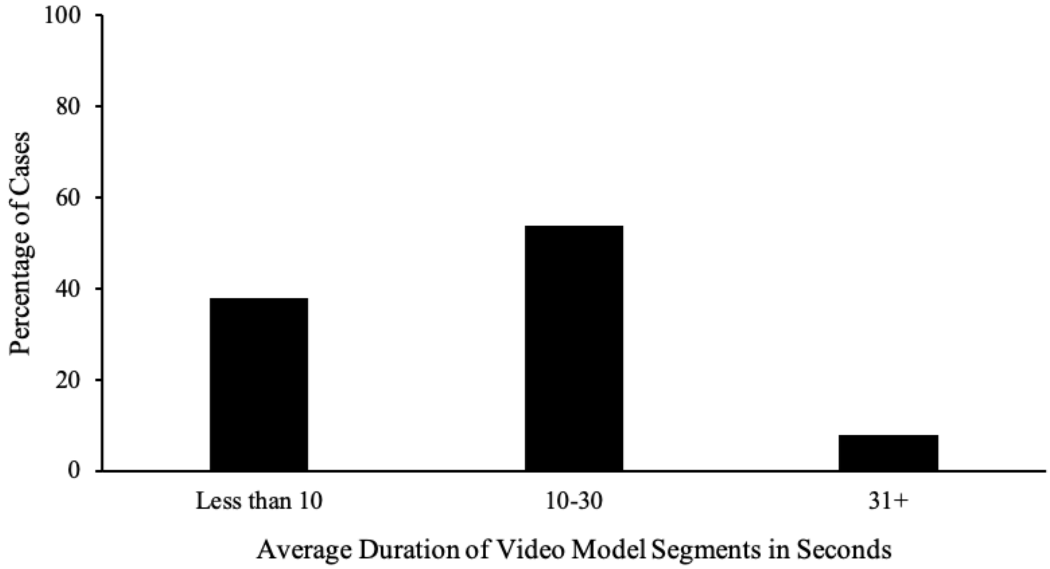

Figure 3. The percentage of cases (n = 50) that reported the average duration of the video model segments (in seconds) for each category.

Of the 189 cases for which the duration was reported, 130 cases reported the range (69%; see Figure 4). Cases were coded in the following categories based on whether the range reported encompassed 50% or more of the category. For example, a reported range of 13-28 seconds would be coded in the category of 16-30 seconds. These ranges were arbitrarily selected; however, 15 second intervals were thought to be a discrete amount of time. Of the 130 cases, 77 cases had a range of less than 16 seconds (59%), 48 cases had a range of 16-30 seconds (37%), and five cases had a range of 61-420 seconds (4%). No cases fell within the criteria for 31-45 and 46-60 seconds.

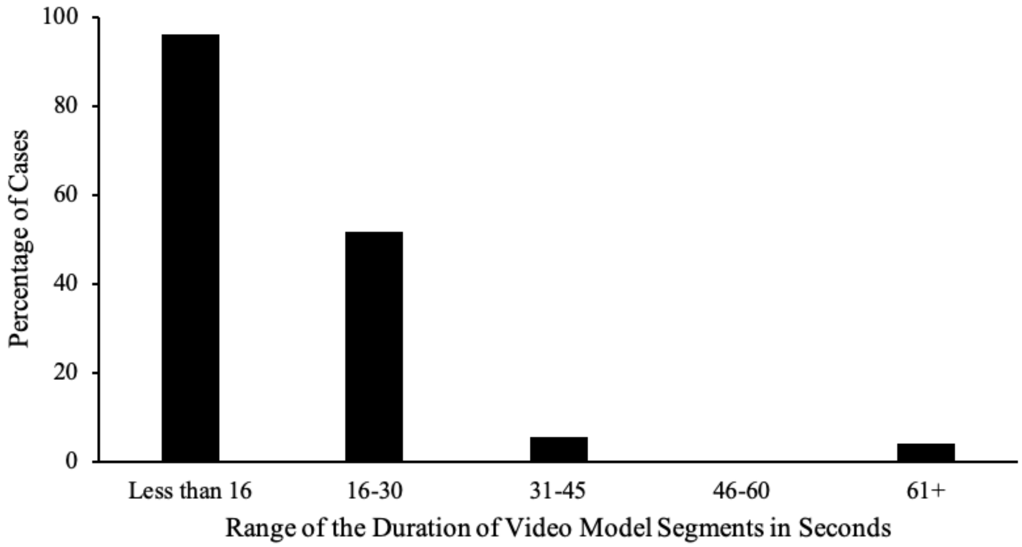

Figure 4. The percentage of cases (*n* =130) that reported the range of the duration of the video model segments (in seconds) for each category.

Discussion

Research has demonstrated that use of evidence-based practices improves outcomes for individuals with ASD. Two interventions that have proven to be such are video modeling and visual supports (Steinbrenner et al., 2020). Video modeling and visual supports have each been used to teach adaptive or daily living skills, social skills, transitions between activities, and vocational skills, to name a few. They have proven to be effective in not only increasing performance of a behavior (e.g., accuracy with washing hands; Jess et al., 2019), but have been effective in reducing problem behavior (e.g., verbal protests during transitions; Zimmerman et al., 2017). However, less is understood about these interventions when they are combined into video activity schedules. Therefore, this review aimed to synthesize the existing literature on use of video activity schedules for individuals with ASD and identify areas for future research.

Within this review, most of the participants included in the studies were male. This is not surprising given that ASD has been found to be four times as common in males than in females (Centers for Disease Control and Prevention [CDC], 2016). The ages of participants ranged from 2-41 years old with most of the participants falling between 12 and 21 years. Upon initial consideration, this finding is surprising considering most of the behavior analytic or special education research conducted with individuals with ASD includes children in the early childhood and elementary school years (e.g., 3-10 years; Chaffee et al., 2017). However, daily living or adaptive skills (e.g., cooking, cleaning) was the most prevalent skill targeted for intervention. IDEA (2004) outlines that transition planning begins when the student receiving special education services is 16, with some states requiring this start earlier. One area of consideration for transition planning is independent living, which may explain the age range within the reviewed studies.

All the participants in this review were required to have ASD; however, nearly half of the participants also had other disabilities or diagnoses reported. The most common of these was intellectual disability, which was reported in 34% of the participants. This finding is consistent with reports that 33% of males and females with ASD have a co-occurring intellectual disability (Maenner et al., 2020). The findings of this review regarding type of disability, or presence of co-morbidity, are consistent with previous reviews (Aljehany & Bennett, 2019; Park et al., 2019). Therefore, future research should continue to examine the utility of video activity schedules for younger children who may not have an intellectual disability to better understand who can benefit most from this type of intervention.

Forty percent of the studies included a measure of generalization; however, this was predominately assessed using novel stimuli. Too often within the fields of behavior analysis and special education researchers and practitioners employ the “train and hope” method in their procedures by collecting data on the participant or client’s ability to engage in the behavior with novel people, settings, or stimuli. A more sufficient way of teaching and generalizing skills for learners with disabilities would be to train multiple exemplars (Stokes & Baer, 1977). Nearly all studies that were conducted within schools were done solely within special education classrooms, including those that assessed academic skills. In order to provide more opportunities for students with disabilities to be included within the general education classroom, this is an area future research should consider when planning studies.

Data were collected on the number or percentage of steps completed correctly in 90% of the included studies. This finding is unsurprising given that the definition of video activity schedules includes a series of video models provided for each step within a task analysis. Therefore, it would seem appropriate to measure effectiveness of the intervention by collecting data on accuracy with engaging in the demonstrated behavior depicted in each of the video models. What is perhaps more surprising is that only three studies included a measure of on-schedule or on-task behavior (Dauphin et al., 2004; Thomas et al., 2020; Torres et al., 2018). Researchers conducted a systematic review on visual activity schedules for individuals with ASD and found that 38% and 44% of the studies included in their review collected data on on-task and on-schedule behavior, respectively (Knight et al., 2015). Similarly, Koyama and Wang (2011) found that 65% of the studies included in their systematic review on activity schedules for individuals with ASD included a measure of engagement or on-task behavior. Since video activity schedules are like activity schedules in concept (i.e., teach a skill or routine) and utility (e.g., daily living skills), it is curious to consider why data collection procedures diverge from measures frequently collected by researchers implementing activity schedules.

Video modeling, and thus video activity schedules, requires much consideration prior to using the intervention. The implementer must consider what is the skill that will be targeted, what type of technology (i.e., device) will be used to record and display the video models, who will serve as the model in the video, how the skill will be performed (i.e., script or task analysis), the duration of the video, and the editing process (Ganz et al., 2011). The current review differs from the other reviews mentioned at the beginning of this chapter in that information was extracted from the studies regarding task analyses, number of video model segments, and duration of video model segments. Considering both researchers and practitioners look to reviews and meta-analyses to guide them in understanding the literature base regarding a particular intervention, it would seem warranted to include this information in not only the individual study, but the review itself. Eighty-two percent of the included studies reported the task analysis used, 85% reported the number of video model segments, and 61% reported the duration of video model segments. While reporting of task analyses and number of video model segments seems rather high and consistent, fewer studies report the duration of the video model segments. It may seem like this information is unnecessary, however, in keeping with the technological dimension outlined in Baer, Wolf, and Risley (1968), researchers should be describing their procedures in a manner that could be easily understandable and replicable by others. This not only would be of importance for replication studies, an area of need within ABA and special education research, but also for practitioners who may wish to use the research procedures to build a program for a client or student. Therefore, researchers should consider reporting this information in future video activity schedules research.

Limitations

This review is not without limitations that should be considered. First, this review was limited to peer-reviewed publications; therefore, dissertations or theses that implemented video activity schedules to facilitate learning for individuals with ASD are not included. Second, while it is believed that the search terms and procedures captured all the relevant literature, there is a possibility that some studies who meet inclusion criteria may have been omitted. Finally, the changes made to the diagnostic criteria for autism in the *Diagnostic and Statistical Manual of Mental Disorders (*5th ed.; DSM–5; American Psychiatric Association, 2013) no longer includes subcategories such as Asperger's Syndrome and PDD-NOS. While studies that included participants with these diagnoses that were identified through the database and ancillary searches were included in this review, they were not used for search terms. Studies that may have had these words in their title or as keywords may not have been captured in the database search.

Implications for Future Research

Research regarding video activity schedules for individuals with ASD has been in existence for 16 years and is an evolution of traditional book activity schedules (MacDuff et al., 1993). The previously noted systematic reviews on activity schedules (Knight et al., 2015; Koyama & Wang, 2011) found that leisure or play activities were targeted in most studies. However, this finding contrasts with the current review that found that 57% of the studies targeted daily living or adaptive skills. Given these findings, future research in video activity schedules should focus on academic skills and leisure skills.

As mentioned previously, most of the studies in the current review were conducted in schools and with individuals who are in the age range consistent with secondary schooling. It seems that most of these studies were conducted in special education classrooms that often have kitchens and laundry rooms to help teach these daily living skills. Of the 10 studies that targeted academics (e.g., math, reading) in schools, only four involved participants who were elementary school aged. Furthermore, Knight et al. (2018) was the only study to be conducted in a general education classroom. Based on these findings, future research should continue to expand the literature on use of video activity schedules to teach academic skills. Emphasis should be given to understanding its use for elementary school aged children with ASD and its use in general education classrooms. Unlike special education classrooms that often have lower teacher-to-student ratios and include multiple support staff, general education classrooms can have anywhere from 20-30 students, depending on the grade level. Within these classrooms, general education teachers are responsible for not only providing effective instruction, but they also monitor the academic and/or behavioral needs of students at-risk for disabilities and students with disabilities (e.g., ASD, learning disabilities). Interventions aimed at promoting academic skill acquisition and on-task behavior would be of benefit in a general education classroom for students and teachers.

This review was intended to synthesize the literature on video activity schedules, therefore, addressing the quality of the studies or analyzing studies through effect sizes was out of the scope. A limited number of studies involving video activity schedules are reported in the Knight et al. (2015) review, which overall identified visual activity schedules to be fairly to highly effective in improving outcomes for individuals with ASD based on single-case research design effect sizes. However, an extensive amount of the literature base is missing from that review, including research that has since been published. Therefore, future research should address these needs to determine whether video activity schedules, like the parent interventions, is also an evidence-based practice for individuals with ASD.

In conclusion, this is the first known comprehensive systematic review regarding video activity schedules for individuals with ASD. The findings of this indicate that participants were primarily males between 12-22 years of age. The skills targeted for intervention were mostly daily living or adaptive skills, and the most common setting was the special education classroom. Future research should focus on teaching academic skills to younger children with ASD in general education classrooms.

CHAPTER THREE

Method

Based on the findings of the literature review, research on using video activity schedules to support academic learning for young children with ASD receiving instruction in the general education classroom is warranted. The purpose of this study was to determine whether video activity schedules can support learning, on-task behavior, and appropriate socializations amongst children with ASD and typically developing peers during cooperative math activities (i.e., math centers). Therefore, the following research questions were posed:

1. To what extent can a within-activity video activity schedule be used to increase accurate completion of a math center activity for children with ASD and typically developing peers?
2. To what extent can a within-activity video activity schedule be used to increase on-task behavior during a math center activity for children with ASD and typically developing peers?
3. To what extent can a within-activity video activity schedule be used to increase appropriate social interactions during a math center activity for children with ASD and typically developing peers?
4. Do children with ASD and typically developing peers prefer or like the use of video activity schedules?

Participants

It was intended for participants with ASD and peer participants without a disability or diagnosis to be recruited for this study from local area public school districts in the Southwest region of the United States. In order to participate in the study, children with ASD had to meet the following criteria: (a) have a medical or educational diagnosis of ASD, (b) be receiving special education services for math instruction (i.e., math goals are identified in the student's Individualized Education Program [IEP]), (c) regularly receive some or all of their math instruction in a general education classroom, including students who may come to the general education classroom for academic centers only, (d) be enrolled in kindergarten, first grade, or second grade, and (e) have no previous experience with video activity schedules (based on information provided by the teacher). Peer participants had to meet the following criteria: (a) have no reported disability or diagnosis, (b) be referred by the general education classroom teacher to participate, (c) be enrolled in kindergarten, first grade, or second grade, and (d) be enrolled in the same class as one of the participants with ASD.

However, many local schools were not willing to collaborate with the researcher due to COVID-19 concerns and restrictions, or they did not have students with an ASD diagnosis who received all or some of their math instruction in a general education classroom. Therefore, an alternative setting and inclusion criteria were added to recruit participants from the current client list and waitlist of a university-affiliated ABA center. Participants with ASD participating at the university-affiliated center setting had to meet the following criteria: (a) have a medical or educational diagnosis of ASD, (b) be receiving special education services for math instruction (i.e., math goals are identified in the student's IEP), (c) be enrolled in kindergarten, first grade, or second grade, and (e) have no previous experience with video activity schedules (based on information provided by the parent). Peer participants at the university-affiliated center setting had to meet the following criteria: (a) have no reported disability or diagnosis and (b) be of similar age (i.e., within 1-2 years) to the participant with ASD.

Three children with ASD and four peers participated in this study. Ray was a 7-year-old White male enrolled in first grade. He was diagnosed with ASD and a speech impairment and was eligible for special education services under both categories. He received all his education in a general education classroom with support provided by a paraprofessional, special education teacher, or an ABA therapist depending on the time and day. His related services included speech therapy, occupational therapy, and ABA, which was provided at the school and the ABA clinic. Ray's teacher referred two peers to participate in the study as his peer partners, Arnav and Ben. Arnav was a 7-year-old, Indian American male, and Ben was a 7-year-old, White male. Arnav and Ben alternated days that they would participate in the research sessions. Ray and his peers formed Dyad 1.

Tristan was an 8-year-old White male enrolled in second grade. He was diagnosed with ASD, attention-deficit hyperactivity disorder (ADHD), and a communication disorder. He was eligible for special education services at school for ASD and speech impairment. He was enrolled in a rural public elementary school that housed students in Pre-Kindergarten to fifth grade. He received all his education in a general education classroom with support from a paraprofessional at certain times of the day. Additionally, he received occupational therapy and speech therapy services from the school and received speech therapy and ABA outside of school. Due to the COVID-19 health pandemic, it was not possible for the researcher to conduct Tristan's sessions in the school setting. Rather, the researcher conducted sessions with Tristan at the university-affiliated center. A similar aged child was recruited from the community to serve as Tristan's peer partner for the study. Felix was a 9-year-old Hispanic male who was enrolled in the fourth grade at school. Tristan and his peer formed Dyad 2.

Simon was a 7-year-old Black male enrolled in first grade. He was diagnosed with ASD and ADHD and was eligible for special education services for ASD and a speech impairment. He used an augmentative and alternative communication (AAC) device via an iPad® and application that produces speech. He was enrolled in a suburban elementary school that housed students in Pre-Kindergarten to fourth grade. He received most of his education in a special education classroom but participated in general education P.E. and music. He received speech and assistive technology related services from the school and received speech and ABA outside of school. Like Tristan, Simon's sessions were conducted at university-affiliated center. A similar aged child was recruited from community to participate as Simon's peer partner. Joshua was a 6-year-old Hispanic male who was enrolled in first grade at school. Simon and his peer formed Dyad 3.

Setting

The research team conducted the study at two different sites. Ray's sessions occurred at a suburban public primary school that served students in grades Pre-Kindergarten to second grade. His first-grade classroom had 20 students enrolled in the class and was taught by one general education teacher with support provided throughout the day by either a paraprofessional, special education teacher, or an ABA therapist. The classroom was furnished with individual desks for each student, one rectangular table for small group instruction with the teacher located at the front of the room near her desk, and one rectangular table for student use located near the back of the room. The front of the room contained a dry erase white board, a Promethean board (i.e., Smart Board), and the teacher's desk. Along one side of the room was a sink area and cabinet storage where technology and small group materials were kept. The other side of the room contained additional storage for academic materials. At the back of the room were lockers and cubbies where students stored their personal belongings and instructional materials (e.g., books). Ray's sessions typically occurred on the floor of the classroom in an open area located near his desk, which was a common setup for centers (i.e., other children were spread out throughout the classroom on either the floor, desks, or tables).

Tristan and Simon's sessions occurred at a university-affiliated center that provided services (e.g., ABA) to individuals with ASD and other developmental disabilities. The center contained a lobby, six individual therapy rooms, one large therapy room used for group sessions, a sensory and playroom, a conference room, two kitchenettes, three bathrooms, two supervisor offices, an office area located next to the lobby where the center manager worked, and an office area located in the back where therapists stored client session materials and worked in between sessions. Live stream cameras were wired in each therapy room and hallway areas. The sessions occurred in a therapy room that contained two rectangular tables, chairs, and a dry erase white board. One of the rectangular tables was arranged in the middle of the room with two chairs for the participants, while the other was pushed up against the wall.

Materials and Task Selection

The research team used several materials including data collection sheets, procedural fidelity checklists, clipboards, and pencils or pens. A GoPro Hero 5 (GoPro, n.d.) was used to record all research sessions. The GoPro was mounted to a small box (i.e., device packaging) in order to keep a low-profile during sessions.

The skills and corresponding math center activities were selected based on input from the classroom teacher, or parents. The researcher asked the teacher or parent to identify a math skill that corresponded to a unit of study that the participant would be working on at school or was written as an IEP goal. Ray's teacher identified place value as a warranted skill to target. Specifically, the skill corresponded to two discrete skills within the Texas Essential Knowledge and Skills (TEKS) for Grade 2: (1) TEKS 2.A, which states that students are expected to "use concrete and pictorial models to compose and decompose numbers up to 1,200...", and (2) TEKS 2.B, which states that students are expected to "use standard, word, and expanded forms to represent numbers up to 1,200" (Texas Education Agency, 2019). Tristan's parents identified counting coins as an appropriate skill to target. Specifically, the skill corresponded to one discrete skill within the TEKS for Grade 2: TEKS 5.A, which states that students are expected to "determine the value of a collection of coins up to one dollar" (Texas Education Agency, 2019). Simon's mother identified addition as an appropriate skill to target. Specifically, the skill corresponded to two discrete skills within the TEKS for Grade 1: (1) TEKS 3.C, which states that students are expected to "compose 10 with two or more addends with and without concrete objects", and (2) TEKS 3.D, which states that students are expected to "apply basic fact strategies to add and subtract within 20…" (Texas Education Agency, 2017). The researcher created the center activities to be like the activities found within corresponding grade level classrooms.

Ray's activity was referred to as "Roll It, Build It, Write It". The participants were required to roll three different colored dice one at a time to identify the hundreds, tens, and ones needed to build the number using base-10 blocks on a place value mat. Then, they were required to identify the number of hundreds, tens, and ones, write the expanded form of those numbers, and then the standard form on a recording sheet. This was to be repeated throughout the session. The smallest number possible was 111 and the largest number was 666. See Table 3 for the task analysis of this activity. The researcher titled Tristan's activity as "How Much Money Is This?" The participants were required to draw a task card that depicted the number and type of coins using written words (e.g., one quarter, three dimes, two nickels, and six pennies). Then, they were required to select and sort the coins on a mat and draw tally marks on a recording sheet for each five within the value of the silver coins (i.e., five tally marks for a quarter, two tally marks for each dime, and one tally mark for each nickel; also referred to as the "hairy money" strategy). Lastly, they counted by fives for each tally mark and then counted on by ones for each penny and wrote the final number on the recording sheet. This was to be repeated throughout the session. The cards ranged in having two coins (e.g., dimes and pennies) to four coins (i.e., quarters, dimes, nickels, and pennies). See Table 4 for the task analysis of this activity. The researcher titled Simon's activity as "Roll It, Add It, Dot It". The participants were required to roll one die to represent the first addend of a number sentence, count out the corresponding number of Unifix cubes, and repeat this process with a second die. Then, they were to count the total number of Unifix cubes to get the sum. Finally, they needed to locate this number on their recording sheet and “dot it” with their dot marker. This was to be repeated throughout the session. The smallest sum that could be obtained was 2 and the largest was 12. See Table 5 for the task analysis of this activity.

The researcher obtained the materials used for each of these activities (e.g., base-10 blocks, play money, dice) from the university’s resource center within the School of Education. The center contained children’s books, assessments, math manipulatives, and other educational materials used in education for students and faculty or staff to check out and use. These materials are all commonly found within classrooms.

Table 3

Task Analysis of “Roll It, Build It, Write It” Activity

Steps	VM segment
1. Pick up and roll the red dice to show how many hundreds to build	1
2. Select and place the matching number of hundreds on the place value mat	
3. Pick up and roll the yellow dice to show how many tens to build	2
4. Select and place the matching number of tens on the place value mat	
5. Pick up and roll the blue dice to show how many ones to build	3
6. Select and place the matching number of ones on the place value mat	
7. Write the value of the number on the first column of the recording sheet (e.g., 1 hundred, 4 tens, 8 ones)	4
8. Write the expanded form of the number on the second column of the recording sheet (e.g., 100+ 40+ 8)	5
9. Write the standard form of the number on the third column of the recording sheet (e.g., 148)	6
10. Clear the base ten blocks off the place value mat and put the blocks back	7

Note. VM video model

Table 4

Task Analysis of "How Much Money Is This?" Activity

Steps	VM segment
1. Pick one task card from the pile	1
2. Read the task card aloud	
3. Pick the correct coins	2
4. Place the coins on the correct column of the coin mat	
5. Say aloud the value of each type of coin on the coin mat (e.g., "A quarter is worth 25 cents, a dime is 10 cents, a nickel is 5 cents, and a penny is 1 cent.")	3
6. Draw five tally marks on the recording sheet for each quarter (e.g., 2 quarters = 10 tally marks)	4
7. Draw two tally marks on the recording sheet for each dime (e.g., 4 dimes = 8 tally marks)	5
8. Draw one tally mark on the recording sheet for each nickel (e.g., 7 nickels = 7 tally marks)	6
9. Count aloud by fives for each tally mark on the recording sheet	7
10. Then, count on aloud by ones for each penny (e.g., 26, 27, 28, 29)	
11. Write the number on the recording sheet	
12. Clear the coins off the math and put the coins back in the pile	8
13. Put the card in the finished pile	

Note. VM video model

Table 5

Task Analysis of "Roll It, Add It, Dot It" Activity

Steps	VM segment
1. Roll the red dice	1
2. Read the number aloud using vocal speech or SGD	
3. Place the dice on the first spot on the addition sentence	2
4. Count out the matching number of Unifix cubes	3
5. Roll the yellow dice	4
6. Read the number aloud using vocal speech or SGD	
7. Place the dice on the second spot on the addition sentence	5
8. Count out the matching number of Unifix cubes	6
9. Count all the Unifix cubes together to get the sum	7
10. Dot the matching number on the recording sheet	8
11. Put the Unifix cubes and dice back	9

Note. VM video model; SGD speech generating device

During the intervention sessions, in addition to the materials already provided during baseline, participants used an iPad®. Ray and his peers also used over-the-ear headphones that were plugged in to the iPad® through a headphone splitter. The iPad® was enclosed in a protective case to prevent any damage. The application, *Choiceworks®* (BeeVisual, n.d.), was used to create the video activity schedule. Through the Schedule Board feature in *Choiceworks®*, users can create a vertically laid out schedule using pictures or videos, including a column to move the pictures or videos to when an activity or task is completed. Additional features include selecting a preferred item (e.g., snack) at the completion of the schedule and adding a visual timer that provides the user with a way to keep track of time to complete an activity. *Choiceworks®* is fully customizable and will save schedules for future use. Currently, *Choiceworks®* is only available on Apple iOS platforms such as the iPhone® and iPad®.

The researcher created video model segments for each step(s) of the activity. Specifically, no more than three steps were modeled. This choice was made by the researcher and was guided by the existing within-activity video activity schedule literature that typically includes one video for each step or a couple of steps depending on how discrete the behaviors are in relation to the following step. For example, in the "How Much Money Is This?" activity, the 7th video model segment contains three steps: (1) skip count by five for each tally mark drawn, (2) continue counting on by ones for each penny, and (3) write the number on the recording sheet. Creating a video model segment for each of these steps may interrupt a chain of behaviors that the learner likely benefits from performing them in tandem without interruption. The videos were created using a Cannon Powershot digital camera and then transferred the videos to the iPad®. Each video was formatted similarly: a performer's (i.e., the researcher) point of view was used to show one step, or a combination of steps, in the task analysis and included voice narration of the step being modeled (e.g., "Roll the dice…three…get three hundred blocks and put them on your place value mat"). The videos were displayed in order of occurrence for the activity under the "First I Need To" column. See Figure 5 for a screenshot of Ray's activity.

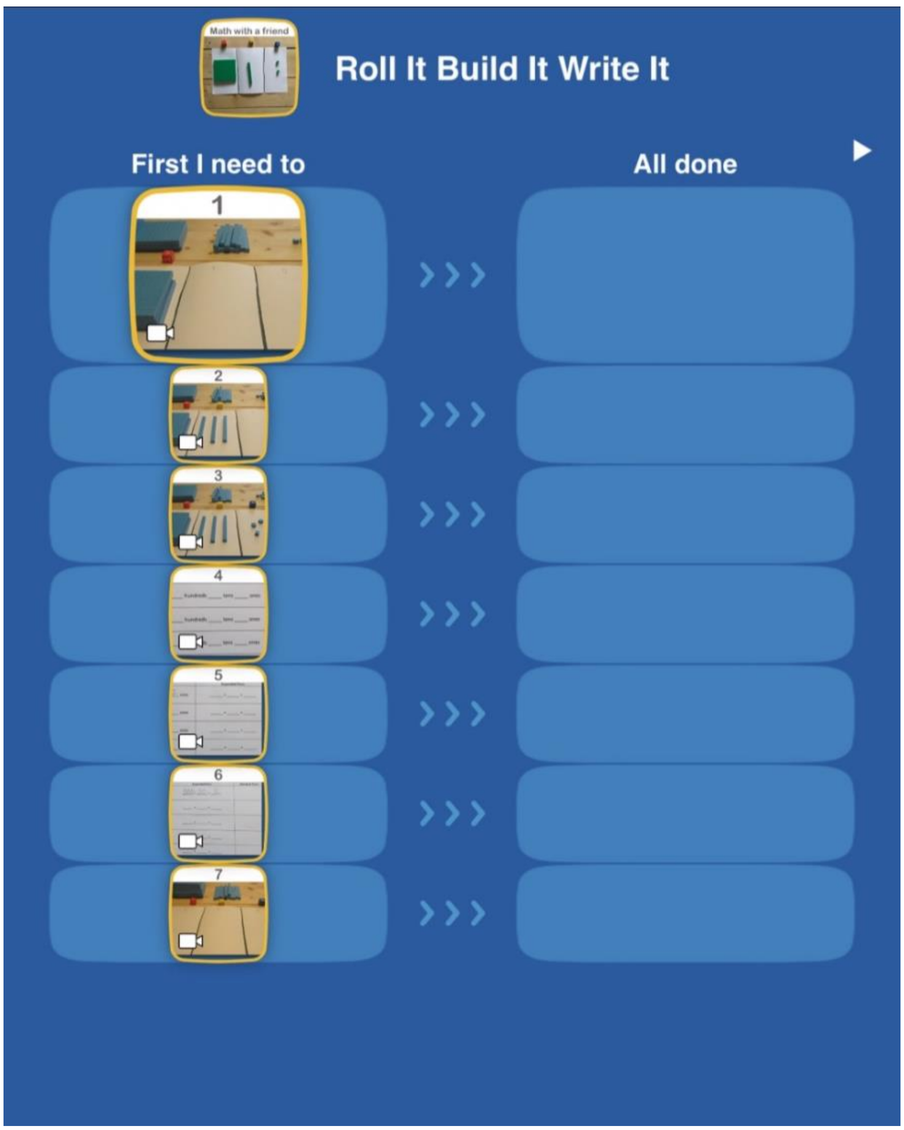

Figure 5. A screenshot of the video activity schedule used for Ray's activity.

Dependent Variables and Data Collection

Data were collected for both the participant with ASD and the peer participant. The primary dependent variable was the percentage of activity steps completed independently and correctly. The researcher developed a task analysis that included each step needed to be completed within the activity. For a response to be counted as correct, it must have independently occurred within the 5 s of completing the previous step in the task analysis or watching the video model segment. For example, in the "Roll It, Add It, Dot It" activity, the participants were expected to watch the first video model segment depicting the model (i.e., researcher) rolling the red dice and saying the number it landed on. The participant had 5 s after the video ended to begin rolling the dice. Then after the dice had stopped, they had 5 s to say the number it landed on, or in Simon's case begin using his device to locate the appropriate number. After saying the number, the participant had 5 s to return to the iPad® and swipe the video icon to "All Done", and then 5 s to select the next video icon. The total number of steps completed correctly were divided by the total number of steps within the task analysis and multiplied by 100 to calculate a percentage.

The secondary dependent variable was the percentage of 10-s intervals with on-task behavior. These data were collected using partial interval recording. This required that the participants be engaged in on-task behavior at any point within the 10 s to be scored as an interval with on-task behavior. On-task behavior was defined as manipulating or engaging with activity materials in the manner that they were intended (e.g., engaging in the targeted step), looking at the iPad® while the video model segment was displayed, pressing play or swiping video model segments, following the directions provided by the voice-over narration in the video activity schedule (e.g., “Draw a card and read it out loud”), or following the directions provided by the researcher (i.e., prompting). The total number of intervals with on-task behavior were divided by the total number of intervals and multiplied by 100 to calculate a percentage.

The tertiary dependent variable was the percentage of 10-s intervals with appropriate social interactions between the participant with ASD and the peer participant. These data were also collected using partial interval recording. This required that the participants engage in appropriate social interactions between one another at any point within the 10 s to be scored as an interval with appropriate social interactions. Appropriate social interactions were defined as verbal, physical, or gestural initiations or responses to a peer (e.g., tapping the peer on the shoulder, giving an item to a peer, or receiving an item from a peer); making a statement or asking a question about the activity or relative to the conversation; responding to a peer’s statement or question with an on-topic statement; or making a physical gesture like shaking the head in disagreement or giving a thumbs up. The total number of intervals with appropriate social interactions were divided by the total number of intervals and multiplied by 100 to calculate a percentage. See Appendix A for the data sheets used for each of the dependent variables.

Interobserver Agreement

To assess the reliability of the data collected on the dependent variables, secondary observers independently collected data in-person or from a video recording to calculate interobserver agreement (IOA). IOA was collected for a minimum of 20% of sessions in each phase of the study (e.g., baseline, intervention) for each participant. Data were collected on all dependent variables using the same data collection sheets as the researcher. An agreement was defined as both observers recording the same step of the task analysis in the same way (primary dependent variable) or recording the same interval in the same way (secondary and tertiary dependent variables). Total agreements were divided by the number of agreements and disagreements and multiplied by 100 for a percentage. Prior to conducting research sessions, the researcher trained the secondary observers on the data collection procedures. Training consisted of reviewing the data sheets, discussing the operational definitions, and discussion of the latency to exhibit a correct response by the participant when completing steps in the task analysis (i.e., 5 s). Throughout the study, if agreement fell below 80%, training was re-instated (i.e., discussion of disagreements and definitions). See Table 6 for the percentage of IOA obtained and agreement results for each participant. IOA was collected for 49% of technology training sessions across all participants. Mean IOA was 99% (range, 93-100%) across all participants.

Table 6

IOA Percentages and Results for Each Participant

Participants	% of Sessions	Primary DV *M* (Range)	Secondary DV *M* (Range)	Tertiary DV *M* (Range)
Dyad 1	BL = 40 INT = 36	Ray = 90 (80-100) Peers = 89 (70-100)	Ray = 92 (76-100) Peers = 93 (79-100)	Ray = 99 (90-100) Peers = 98 (87-100)
Dyad 2	BL = 100 INT = 59 PREF = 100 MAINT = 100	Tristan = 96 (84-100) Felix = 95 (82-100)	Tristan = 92 (67-100) Felix = 95 (80-100)	Tristan = 92 (67-100) Felix = 95 (80-100)
Dyad 3	BL = 44 INT = 29	Simon = 100 Joshua = 92 (73-100)	Simon = 91 (70-100) Joshua = 86 (63-100)	Simon = 100 Joshua = 95 (77-100)

Note. DV dependent variable, BL baseline, INT intervention, PREF child preference, and MAINT maintenance

Procedures

General Procedures

All research sessions were 5 min. Ray's research sessions occurred 2-6 times a day, 4-5 days week. Tristan's sessions occurred 5-6 times a day, once a week. Simon's sessions occurred 4-8 times, 1-2 days a week. All activity materials needed for all sessions were present; however, the iPad® was only present during the technology training and intervention phases. The researcher was situated near the participants to provide prompting as needed.

Participants were provided with preferred tangible items (i.e., edibles, toys/play time) and praise at the end of the session. Tangible items were provided at the end of each session or a series of sessions (i.e., three or four), while praise was provided at the end of each session. To identify preferred items, the researcher used information provided by teachers, therapists, parents, and the participants themselves. Ray's teacher provided the researcher with two edible items that Ray earns in the classroom as reinforcement for completing his work and participating during instruction. His ABA therapist further explained that these items were identified through a preference assessment that was conducted earlier in the school year. His peers' items were identified by the teacher based on discussion with the peers (i.e., the teacher asked, "What do you want to earn for helping with Ray's activity?"). Ray's preferred edible items were Skittles®, which were provided noncontingently at the conclusion of the day's sessions. His peers received one small toy from the teacher, which were also delivered noncontingently at the end of the day's sessions. For Tristan and Felix, the researcher presented them with two options from which they could select, and the selected stimulus was to be delivered at the conclusion of three sessions (i.e., noncontingent). Tristan and Felix's preferred activity was to play in the playroom. Simon's mother provided the researcher with information regarding his preferred edibles based on what Simon receives as reinforcers for his ABA sessions and at school. Since Simon was receiving preferred edible items, the researcher decided to provide the same type of item (i.e., edibles) to Joshua. Joshua's mother told the researcher a variety of snacks that Joshua likes and that she was comfortable letting him have. Both Simon and Joshua were asked at the conclusion of the session to select which edible item they would like to have from an array of two items. Simon's preferred edibles were M&Ms® and Skittles®, while Joshua's preferred edible items were Goldfish® and pretzels.

Outside of the sessions, the researcher used behavioral interventions familiar to the participant with ASD according to teacher or parent report. For Ray, this was a verbal First, Then reminder (i.e., "First work with your friends, then you can have Skittles when we're all done); for Tristan, this was a visual schedule in written words of the session written on the whiteboard to be checked off as each thing was completed (i.e., Session 1, Session 2, Session 3, Play, Session 4, Session, 5, Session 6); and for Simon, this was a First, Then visual schedule (i.e., first work icon, then snack icon).

Baseline

The purpose of the baseline condition was to determine whether the participants were able to complete cooperative math center activities without the presence of the iPad® and video activity schedule. The researcher told the participants that they were expected to complete their activity, but that the researcher would not provide help. The participants were often told, "Just try your best". For Ray, the teacher provided general praise and correction to the class as she typically would but refrained from providing specific feedback on how to complete the activity to the participants. The baseline condition occurred for a minimum of five sessions for each dyad.

Technology Training

Prior to intervention sessions, the researcher taught all participants, including the peers, how to use *Choiceworks*® and the video activity schedule with a mastered task(s). For Ray, Tristan, and their peers, as well as Simon's peer, this included sorting items by color. The video activity schedule was comprised of six video models. Each video model depicted the model (i.e., the researcher) picking up three dinosaurs of the same color from a group of dinosaurs and placing them in the same-colored bowl from an array. For Simon, four mastered tasks were used: placing a single-colored dinosaur into the matching-colored bowl from an array of two, stacking three blocks on top of one another, matching the same alphabet letter from an array of two, and finishing a wooden farm animals puzzle with two pieces. Each task was a video model in the video activity schedule and depicted the researcher modeling the task. Each video was accompanied with voice narration by the researcher (e.g., "Pick up three green dinosaurs...1...2...3...and put them in the green bowl"). The participants selected the first video model in the schedule, watched the video model in its entirety, imitated the video, and swiped the video from the "First I Need To" column to the "All Done" column. When all videos had been viewed, the participants were expected to reset the schedule by selecting the reset button in the top right corner of the application.

The initial training session for the participant with ASD consisted of errorless teaching where the researcher physically helped the participant through each part of the schedule. The researcher provided a verbal cue ("Let's do your color sorting schedule. Watch number one.") and physically prompted the participant to select the first video in the schedule. When the video model ended, the researcher then provided a verbal cue ("Your turn") and physically prompted the participant to perform the step demonstrated in the video. When the step was completed, the researcher provided a verbal cue ("All done with number one") and physically prompted the participant to swipe the video to the "All Done" column. This process was repeated until all steps in the activity were completed. When all the video models had been moved to the "All Done" column, the researcher provided a verbal cue ("We need to reset the schedule"), and physically prompted the participant to press “Reset” twice on the iPad®. During the next training session, the researcher waited 5 s for the participant to engage in the target behavior. If the participant did not engage in the step, the researcher used a verbal prompt (Ray and Tristan) or physical prompt (Simon) to help them complete the step. A similar process was used for the peer participant; however, during the errorless teaching session, the researcher provided verbal prompts rather than physical prompts. For the training to be terminated, participants were expected to independently navigate the technology and imitate the video models with 100% accuracy for two consecutive sessions. See Appendix A for the data sheet used for technology training.

Video Activity Schedules

After the technology training was completed, the intervention phase began. Prior to the first session occurring that day, the researcher randomly selected which participant was responsible for navigating the iPad® and the introductory materials for the first session. For Ray and Simon’s activities, the introductory materials were the dice, and for Tristan’s activity, this was the task card. After the first session, the participants alternated who was responsible for navigating the iPad® and introductory materials for each subsequent sessions (e.g., 1st session = Ray, 2nd session = Arnav, 3rd session = Ray). The iPad® was situated between the participants so they could view it simultaneously. At the beginning of every session, the researcher instructed the participants to use the video activity schedule to complete the activity. If the participants did not engage in the target behavior within 5 s or made an error based on the sequence of steps depicted in the task analysis, the researcher used a verbal prompt (e.g., “You need to get 3 hundred blocks”) to complete the step and the step was scored as incorrect. If Ray or Tristan did not engage in the desired behavior, a least to most prompting hierarchy was initiated (i.e., gesture prompt, model prompt, partial physical prompt). For Simon, a least-to-most hierarchy of verbal then a physical prompt was used. The difference for Simon was decided upon as Simon's IEP indicated that physical prompts served as a controlling prompt. The researcher repeated verbal prompts for the peer participant. Termination of the intervention phase was contingent on the participant with ASD reaching mastery criteria, which was based on the primary dependent variable and set for at least 90% accuracy across three consecutive sessions, or five consecutive sessions with stable data.

Booster Session

Prior to the 9th session, a booster session was implemented with Ray. This booster consisted of an errorless teaching session (i.e., no time delay to prompt responses) during the activity while the peer was in control of the iPad® and introductory materials (i.e., dice). For example, immediately after the peer rolled the dice (i.e., steps 1, 3, 5), the researcher physically prompted Ray to select the corresponding base-10 blocks and place them on his place value mat. After the video models ended for steps that did not require the peer to act first (i.e., steps 7-10), the researcher verbally prompted Ray to complete the required step. This booster session lasted for approximately 20 minutes and contained three practice opportunities.

Child Preference

To capture social validity from Dyad 2 (i.e., Tristan), a preference phase was conducted after the completion of the intervention phase. The same procedures described during the intervention phase were used; however, prior to beginning the activity, the researcher had the participant with ASD choose whether the dyad would use the video activity schedule to complete the activity. If the participant had chosen not to use the video activity schedule, they would not have been provided with the iPad®. If the participant chose to complete the activity using the video activity schedule, they were provided with the iPad®. This phase occurred for three sessions. A preference phase was unable to be conducted for Ray and Simon.

Maintenance

The researcher collected maintenance data for Dyad 2 two weeks after the child preference phase was completed to determine if the participants were able to maintain their skills with the video activity schedules. The procedures used were like the baseline phase; however, the video activity schedule was present. Participants were instructed to complete their activity but were not provided any additional prompts as to how to complete the activity or to stay on task.

Procedural Fidelity

To assess whether the researcher implemented all aspects of the research protocol correctly, a secondary observer collected procedural fidelity data in-person or from a video recording. Procedural fidelity was collected for 86% of all baseline sessions, 62% of all technology training sessions, 55% of all intervention sessions, 100% of all booster sessions, 33% of all child preference sessions, and 100% of all maintenance sessions. The secondary observer used a fidelity checklist that was created specifically for each phase of the study. Prior to conducting research sessions, the researcher trained all secondary observers on the checklist. Training consisted of reviewing and discussing the checklists for each phase of the study. During research sessions, the researcher was expected to meet a minimum of 80% correct implementation. The secondary observers provided the researcher with feedback on their procedural fidelity at the conclusion of each session in which live procedural fidelity were collected, or after multiple sessions were watched from a video recording. The average procedural fidelity was 92% (range, 80-100%), 98% (range, 80-100%), and 97% (range, 75-100%) for Ray, Tristan, and Simon, respectively. See Appendix B for the checklists used for each phase.

Experimental Design

This research study used single-case research methodology. Single-case research involves a single case (e.g., individual participant, group of participants like a classroom of students), repeated measures to collect data on effects of the independent variable (i.e., intervention) on the dependent variable across phases of the study, and the participant(s) serves as their own control (i.e., baseline performance). Single-case designs allow researchers to demonstrate experimental control of the independent variable on the dependent variable and these designs are widely used in special education and behavior analysis research (Kratochwill & Levin, 2014). The What Works Clearinghouse (WWC) standards for single-case research design were followed, to the best extent possible, for each phase of this study (U.S. Department of Education, Institute of Education Sciences, WWC, 2020). These standards provide guidance for high quality research by expecting (a) the researcher systematically manipulate the independent variable, (b) IOA data be collected for a minimum of 20% of research sessions in each phase and with a minimum agreement of 80%, (c) a minimum of 3-5 data points be collected in each phase of the study for every case, and (d) at least three attempts to demonstrate experimental control are evident based on a visual graph. For this study, the researcher manipulated the independent variable based on the data, collected IOA for each participant in each phase of the study for a minimum of 20% of sessions, collected a minimum of five data points in baseline and intervention phases for each participant, and attempted to demonstrate experimental control with three participants (i.e., three attempts). The specific single-case research design used was a nonconcurrent multiple baseline design across participant dyads to evaluate the use of video activity schedules on accurate task completion, on-task behavior, and appropriate social interactions amongst participants.

Data Analysis

Data were displayed visually on three separate graphs, one for each dependent measure, with a data path for each participant. Visual analysis of the data within and between conditions was used to determine the effectiveness of the video activity schedule. Within each condition, the researcher assessed the data for variability (i.e., how consistent the data are), level (i.e., the average of the data), and trend (i.e., the direction the data are going such as increasing or decreasing). Between the conditions, the data were assessed for an immediacy of effect (i.e., the difference in level from the last three data points in baseline compared to the first three data points in intervention), overlap (i.e., the number of data points that overlap from the previous phase), and consistency of the data (i.e., whether data are similar in identical phases such as two baseline phases; Cooper et al., 2007). Additionally, single-case effect sizes were calculated using Tau-*U* and an online calculator (Vannest et al., 2011). Tau-*U* is a nonparametric technique that indicates the extent to which improvement is made by comparing non-overlapping data between two phases such as baseline and intervention. This method was selected as it has greater strengths over other single-case effect sizes such as being suitable for small sample sizes, correcting for improvements in baseline data, and it will yield a *p* value (Parker et al., 2011).

Social Validity

At the conclusion of the study, social validity was collected from Ray's teacher and all peer participants. An adapted version of the Intervention Rating Profile-15 (IRP-15; Martens, Witt, Elliott, &Darveaux,1985) was given to the teacher. The IRP-15 contains 15 items that are rated on a six-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = somewhat agree, 5 = agree, and 6 = strongly agree) that assesses the acceptability of the intervention. The scores are totaled with higher scores indicated greater levels of acceptability. The IRP-15 was adapted by the researcher to replace wording such as "child" with "student" and "problem behavior" with "needs". The adapted social validity measure can be found in Appendix C.

To capture social validity from the peer participants, the researcher conducted a post-intervention interview. The questions asked were: "Do you like using the video activity schedule on the iPad® to do the math activity?", "What did you like or not like about the video activity schedules?", and "Do you think the video activity schedules were helpful for you and your partner?"

CHAPTER FOUR

Results

Percentage of Steps Completed Correct and Independent

Figure 6 displays the data for the percentage of steps completed correct and independent for the targeted math activity, which was the primary dependent variable for this study.

Dyad 1

During baseline, Ray completed 0% of the steps correct across all five sessions, which indicated a low level of performance with a stable trend. His peer, which was Arnav for all of baseline, completed an average of 73% of steps correct (range, 60-80%). He performed at a moderate-to-high level with minimal variability in his data. However, as mentioned previously, changes in phases within the study (e.g., baseline to technology training) were contingent on the participant with ASD's performance with the primary dependent variable; therefore, Dyad 1 moved to the next phase of the study. During the technology training phase, Ray required three sessions to reach mastery criteria. Arnav and Ben only required two sessions each.

During intervention, an immediacy of effect was observed for both Ray and his peers from baseline to intervention. The level of the data increased and contained no overlapping data points for the first three sessions of intervention; however, the subsequent sessions displayed a significant amount of variability, particularly for Ray.

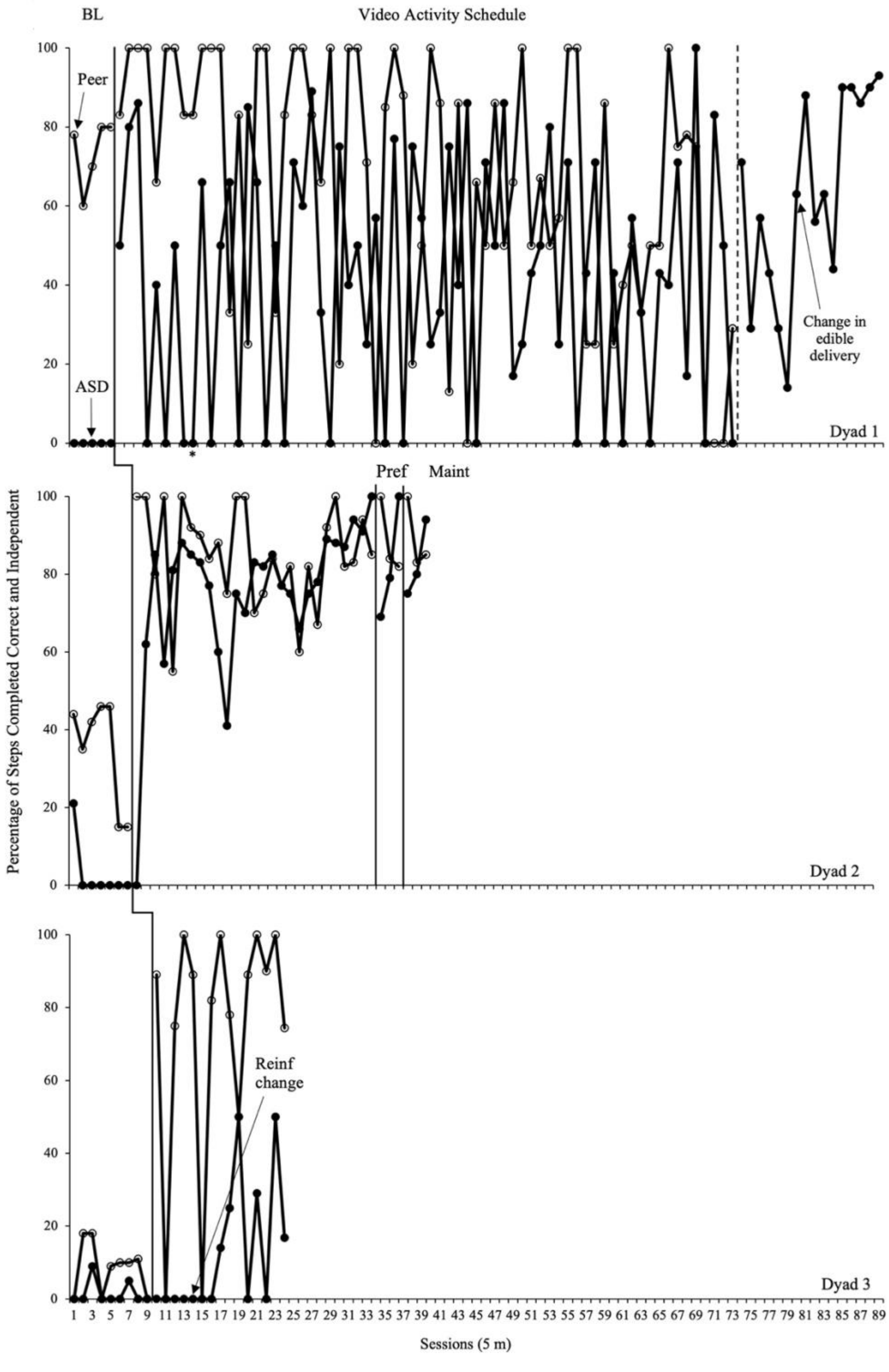

Figure 6. Percentage of steps completed correctly for each participant dyad. Closed circles represent the participant with ASD and open circles represent the peer participant. The (*) denotes a booster session occurring prior to that session.

He had numerous sessions with 0% accuracy, all of which occurred when the peer was responsible for navigating the iPad® and controlled the introductory materials for the session. He completed an average of 42% of steps correct across all 68 sessions (range, 0-100%). Figure 7 displays the data for Ray's performance separated by whether Ray was responsible for the materials or the peer.

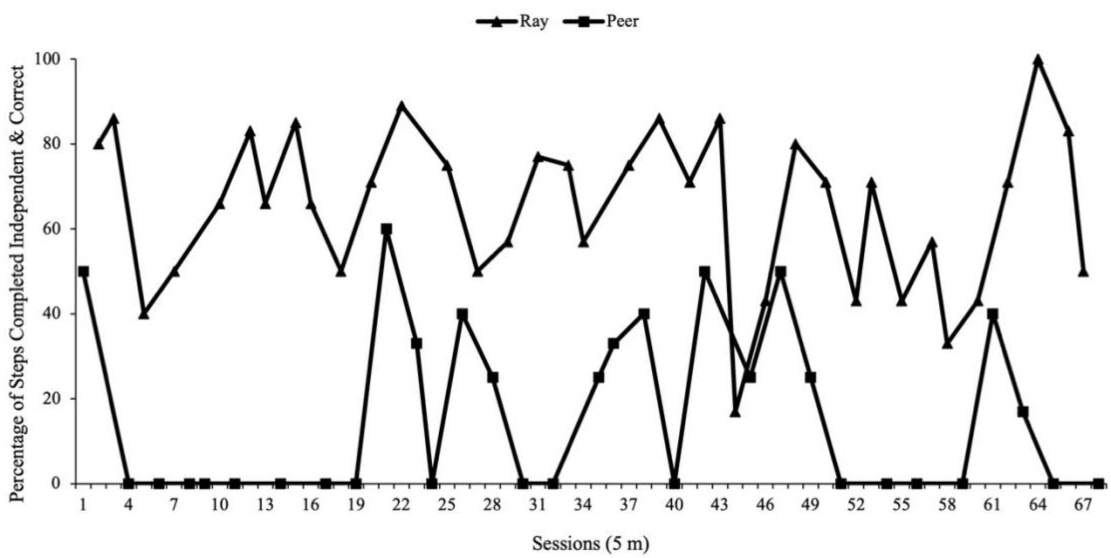

Figure 7. Ray's percentage of steps completed correctly separated by when Ray was responsible for the iPad® and introductory materials (triangles) and when the peer was responsible (squares).

When Ray was responsible for the iPad®, he completed an average of 65% of the steps correct (range, 17-100%). In contrast, when he was not responsible for the iPad®, he completed an average of 16% of steps correct (range, 0-60%). His data were observed to be variable and low when the peer was responsible for the materials. Therefore, a phase change was made to assess Ray's performance with the activity without the peer present. During this phase, a change in the schedule of delivery of preferred edible items was made from every three or four sessions (i.e., end of the day), to every two or three sessions (i.e., half of the sessions for the day). The change in delivery occurred for the last 10 sessions of the study, which occurred over two days (i.e., four sessions, six sessions). This change occurred during Session 80 (i.e., 7^{th} individual activity session) and is noted on the graph. His performance improved with an overall increasing trend; however, his data remained variable. He completed an average of 63% of steps correct across all 16 sessions of this phase (range, 14-93%). Ray met mastery criteria (i.e., three consecutive sessions with 90% or greater) in Session 89, which was Session 16 of the individual activity. Due to time constraints and the end of the school year, the researcher was unable to collect child preference and maintenance data for Dyad 1.

Dyad 2

During baseline, Tristan completed an average of 3% of the steps correct across all seven sessions (range, 0-21%), which indicated a low level of performance with a stable trend for the last six sessions. His peer, Felix, completed an average of 35% of steps correct (range 15-46%). His data had minimal variability for the first five sessions and then decreased for the last two sessions. Because Tristan's data were stable, Dyad 2 moved to the next phase of the study. During the technology training phase, both Tristan and Felix required only two sessions to demonstrate mastery criteria.

During intervention, an immediacy of effect was seen for Tristan and Felix, from baseline to intervention. The data increased in level from baseline and had no overlapping data points except for Tristan's first session in intervention; however, the data are variable for both participants. Tristan completed an average of 75% of the steps correct (range, 0-100%) and Felix completed an average of 85% of the steps correct (range, 55-100%) across all 27 sessions. Tristan reached mastery in Session 32, which was the 27th intervention session. During the child preference phase, Tristan and Felix had similar levels of accuracy compared to intervention. Tristan had an increasing trend and completed an average of 83% of the steps correct (range 69-100%), while Felix had a slight decrease but completed an average of 89% (range, 82-100%). During maintenance, Tristan and Felix maintained similar levels to intervention. Both Tristan and Felix had a similar trend to the preference phase. Tristan completed an average of 83% of the steps correct (range, 75-94%), and Felix completed an average of 89% (range, 83-100%) across the three sessions.

Dyad 3

During baseline, Simon completed an average of 2% of steps correct across all nine sessions (range, 0-9%), which indicated a low level of performance. His peer, Joshua, completed an average of 8% of steps correct (range, 0-18%), which also indicated a low level of performance. Therefore, Dyad 3 moved on to the next phase of the study. During the technology training phase, Joshua required two sessions to demonstrate mastery criteria. Simon did not demonstrate mastery criteria. Table 7 shows Simon's average performance for each step, as well as the first half of the training sessions and the second half of the training sessions. For some steps, he improved as time in training progressed; however, for some, he regressed. Overall, he plateaued at about 50% across all sessions despite four errorless teaching sessions. Because he could imitate the videos correctly and was relatively consistent with this skill, it was decided that he begin intervention despite his not meeting mastery criteria.

Table 7

Simon's Performance During Technology Training

Step	Total	Session 1-14	Session 15-27
1. Select the "1" icon	42%	21%	62%
2. Watch the video	100%	100%	100%
3. Follow the video: pick up the green dinosaur and put it in the green bowl	100%	100%	100%
4. Move the "1" icon to All Done	11%	21%	0%
5. Select the "2" icon	4%	0%	8%
6. Watch the video	100%	100%	100%
7. Follow the video: stack the blocks on top of each other	86%	86%	85%
8. Move the "2" icon to All Done	15%	29%	0%
9. Select the "3" icon	12%	0%	23%
10. Watch the video	97%	93%	100%
11. Follow the video: match letter A	90%	79%	100%
12. Move the "3" icon to All Done	4%	7%	0%
13. Select the "4" icon	11%	14%	8%
14. Watch the video	97%	93%	100%
15. Follow the video: finish the puzzle	90%	79%	100%
16. Move the "4" icon to All Done	11%	14%	8%
17. Push "Reset" in the top right corner	12%	0%	23%
18. Push "Reset" in the pop up	23%	0%	46%

Note. Data were not collected on performance during errorless teaching sessions.

During intervention, Simon's data remained unchanged as he did not independently complete steps. Therefore, it was decided, to introduce reinforcement (i.e., preferred edibles) contingent on each response within the task analysis rather than waiting until the end of the session. Beginning on the fifth session, Simon received an edible item for completing each step within the task analysis, including prompted and unprompted responses. The researcher provided one M&M® Mini or half of a Skittle® for prompted responses and three M&M® Minis or a whole Skittle® for unprompted responses. During Sessions 5-16, Simon completed an average of 17% of steps correct (range, 0-50%); however, the data were variable. Joshua completed an average of 74% of steps correct (range, 0-100%). His data had some variability but were overall at a moderate to high level. Due to scheduling conflicts, the researcher was unable to collect additional data for Dyad 3.

Effect Size

The weighted Tau-*U* effect size for the primary dependent variable across all participants with ASD was 0.64, $p < .001$, indicating a large change. The effect size across all participants, including the peer, was 0.63, $p < .001$. This includes data from baseline and intervention only; the child preference, maintenance, and individual application for Ray, were not included. For Ray's improvement between baseline and intervention when he completed the activity individually was 1.0, $p < .001$, indicating a very large change.

Percentage of Intervals with On-task Behavior

Figure 8 displays the data for the percentage of 10-s intervals with on-task behavior during the math activity, which was the secondary dependent variable for this study.

Dyad 1

During baseline, Ray was on task for an average of 33% of the intervals (range, 10-50%). His data showed a decreasing trend over the first three sessions, while the final

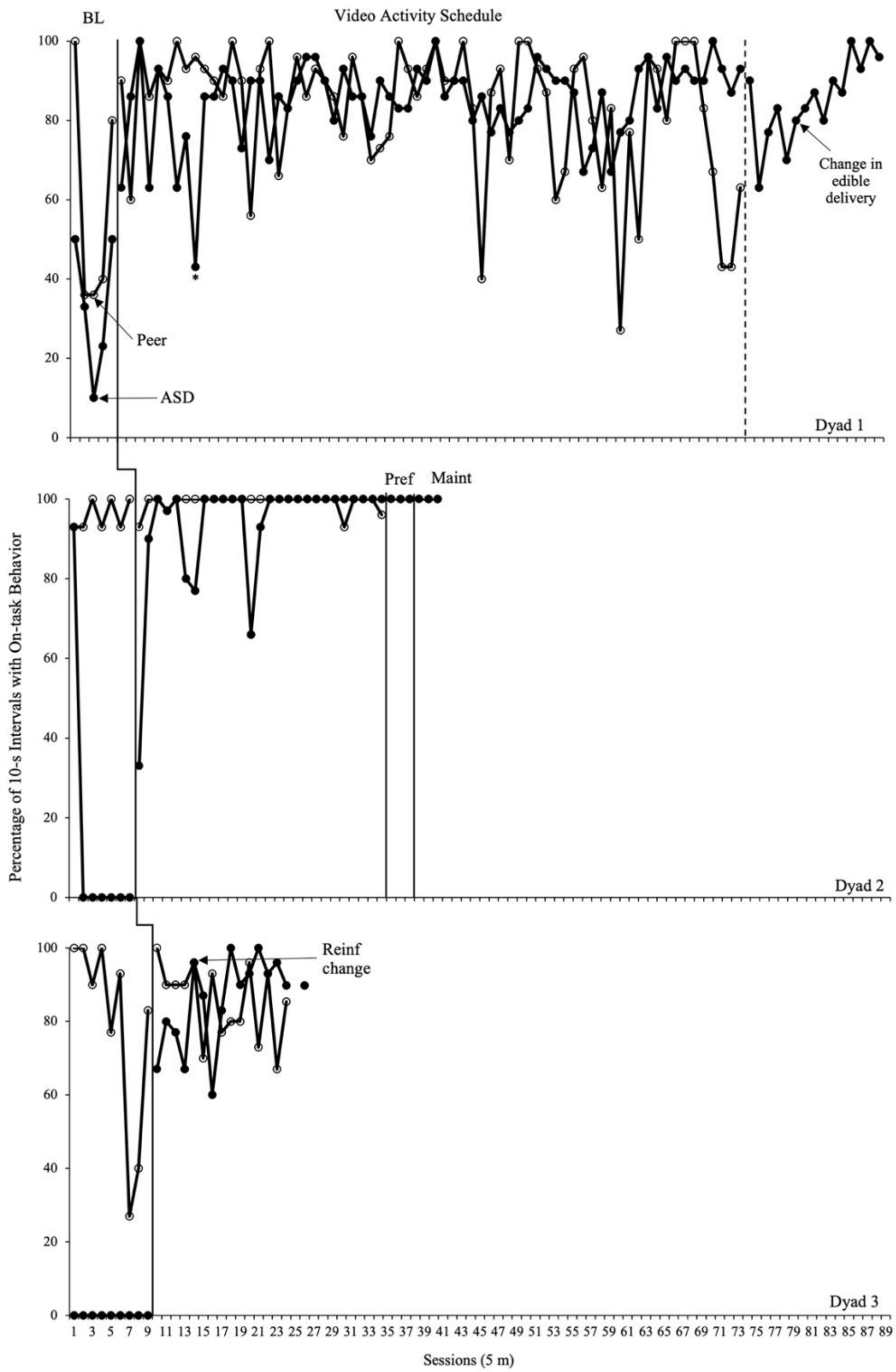

Figure 8. Percentage of 10 s intervals with on-task behavior for each participant dyad. Closed circles represent the participant with ASD and open circles represent the peer participant. The (*) denotes a booster session occurring prior to that session.

two sessions showed an increase. His peer, Arnav, was on task for an average of 58% of the intervals (range, 36-100%), with a similar pattern in the data as Ray's. During intervention, an immediacy of effect was observed for Ray with an increase in level and minimal data points (i.e., two) overlapping with baseline; however, like the primary dependent variable there was variability in the data. Ray was on task for an average of 85% of the intervals (range, 43-100) across all 68 sessions. The peers were on task for an average of 83% of the intervals (range, 27-100%). Figure 9 displays the same data as Figure 8 but notes who was responsible for the materials. In 38 of the 68 sessions (56%) the participant responsible for the materials was more on task than the other, while for eight of the 68 sessions (12%) both Ray and his peer were on task equally.

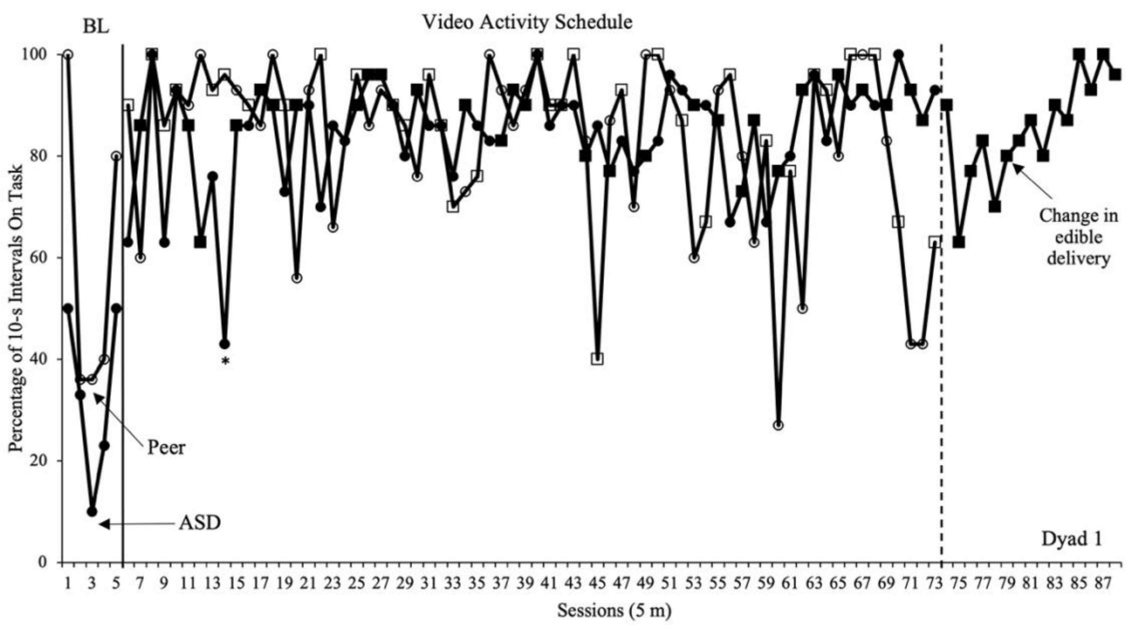

Figure 9. Percentage of 10-s intervals with on-task behavior for each participant dyad. Closed circles represent the participant with ASD and open circles represent the peer participant. Closed squares represent when Ray was responsible for the materials, and open squares represent when the peer was responsible for the materials. The (*) denotes a booster session occurring prior to that session.

Dyad 2

During baseline, Tristan was on task for an average of 13% of the intervals across all five sessions. His first session indicated 93% of intervals were on task; however, subsequent sessions were all 0%. After the first session, Tristan vocalized to the research team that he did not want to complete the activity and was observed engaging in disruptive behaviors such as vocal protests, whining, and dropping from the chair to the floor. His peer, Felix, was on task for an average of 96% of the intervals (range, 93-100%). The data indicated a high level of on-task behavior with minimal variability. During intervention, an immediacy of effect was observed for Tristan as his data increased in level from baseline, had minimal variability, and even remained stable for the final 13 sessions at 100%. He was on task for an average of 94% of the intervals across all 27 sessions (range, 33-100%). Felix retained his high level of on-task behavior from baseline with an average of 99% of the intervals (range, 93-100%). During the child preference and maintenances phases both Tristan and Felix were on task for 100% of the intervals.

Dyad 3

During baseline, Simon was on task for 0% of the intervals. Anecdotally, the research team observed that Simon engaged in frequent stereotypy and disruptive behavior that were incompatible with on-task behavior. His peer, Joshua, was on task for an average of 79% of the intervals across all nine sessions (range, 40-100%). During intervention, an immediacy of effect was observed for Simon as his level changed from baseline with minimal variability and had an overall increasing trend. He was on task for an average of 90% of the intervals across all 14 sessions (range, 60-100%). Joshua's data were similar to baseline with variability and slightly decreasing trend. He was on task for an average of 85% of the intervals across all 14 sessions (range, 67-100%). Figure 10 displays the same data as Figure 8 but notes who was responsible for the materials. In 11 of the 14 sessions (79%) the participant responsible for the materials was more on task than the other, while for one of the 14 sessions (7%) both Ray and his peer were on task equally.

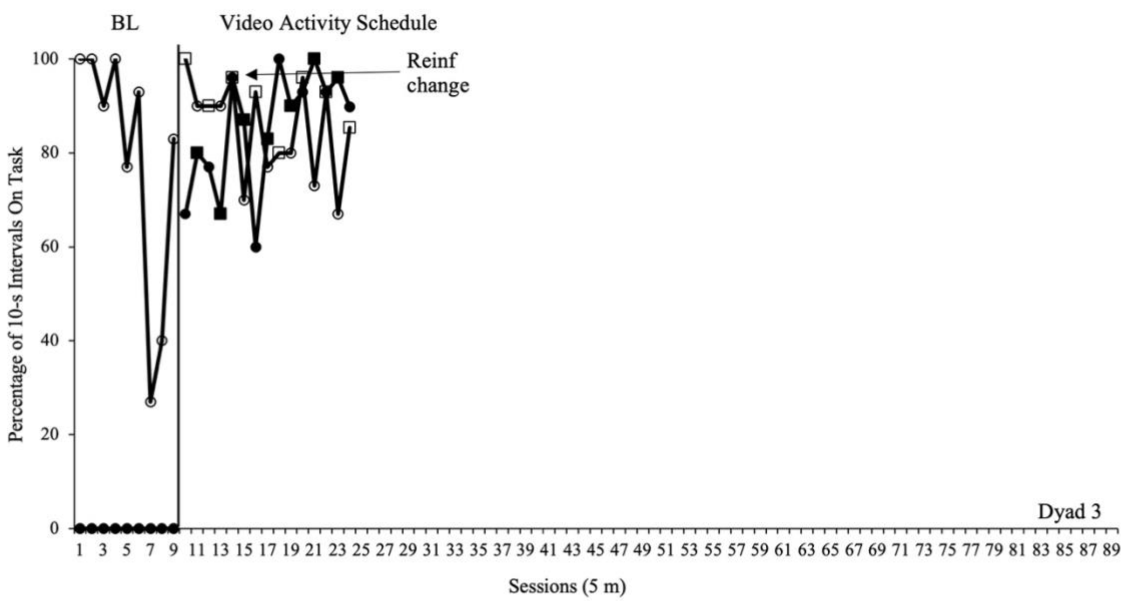

Figure 10. Percentage of 10-s intervals with on-task behavior for each participant dyad. Closed circles represent the participant with ASD and open circles represent the peer participant. Closed squares represent when Simon was responsible for the materials, and open squares represent when the peer was responsible for the materials.

Effect Size

The Tau-*U* effect size for the secondary dependent variable across all participants with ASD was 0.99, $p < .001$, indicating a very large change. The effect size across all participants, including the peer, was 0.66, $p < .001$, indicating a moderate change. The same phases were applied to this calculation as the primary dependent variable.

Percentage of Intervals with Appropriate Socializations

Figure 11 displays the data for the percentage of 10-s intervals with appropriate socializations amongst participants during the targeted math activity, which was the tertiary dependent variable for this study.

Dyad 1

During baseline, neither Ray nor his peer, Arnav, engaged in appropriate socializations. Arnav would often comment to the researcher about something regarding Ray but did not direct his comments or questions directly to Ray. During intervention, both Ray and his peers continued to have low levels of appropriate socializations amongst one another. Ray had an average of 0% of intervals with appropriate socializations across all 68 sessions (range, 0-6%). His peers had an average of 3% of intervals (range, 0-23%) with Ben having more sessions than Arnav with any appropriate socializations. These data were not collected when Ray switched to an independent rather than cooperative activity.

Dyad 2

During baseline, Tristan engaged in appropriate socializations for an average of 4% of the intervals (range, 0-30%). His peer engaged in appropriate socializations for an average of 3% of the intervals (range, 0-20%). Both Tristan and his peer verbally communicated with one another and helped each other find the needed coins to put on their place value mats during their first session. During the second session, Felix told him, “C’mon you can do it” when Tristan initially displayed disruptive behavior but did not interact with him any further that session or subsequent sessions.

During intervention, Tristan’s appropriate socializations improved from baseline but remained in a low-to-moderate level and were variable. He had an average of 10% of intervals with appropriate socializations across all 27 sessions (range, 0-40%). Felix’s data were also variable but remained at a lower level than Tristan with an average of 2% of intervals (range, 0-13%). During the child preference phase, Tristan and Felix’s appropriate socializations were at a similar level to intervention. Tristan had an average of 49% of intervals with appropriate socializations (range, 47-50%), while Felix had an average of 24% (range, 17-27%) across the three sessions. During maintenance, Tristan and Felix maintained similar levels to intervention. Tristan had an average of 19% of intervals with appropriate socializations (range, 10-27%), while Felix had an average of 3% (range, 0-10%) across the three sessions.

Dyad 3

During baseline, Simon had an average of 0% of intervals with appropriate socializations across all nine sessions (range, 0-3%). His peer, Joshua, had an average of 1% of intervals (range, 0-3%). During intervention, Simon did not engage in any appropriate socializations with Joshua. He primarily communicated requests for edibles from the research team or to use the bathroom. Joshua’s data were variable but did increase from baseline. He had an average of 19% of intervals with appropriate socializations (range, 0-43%).

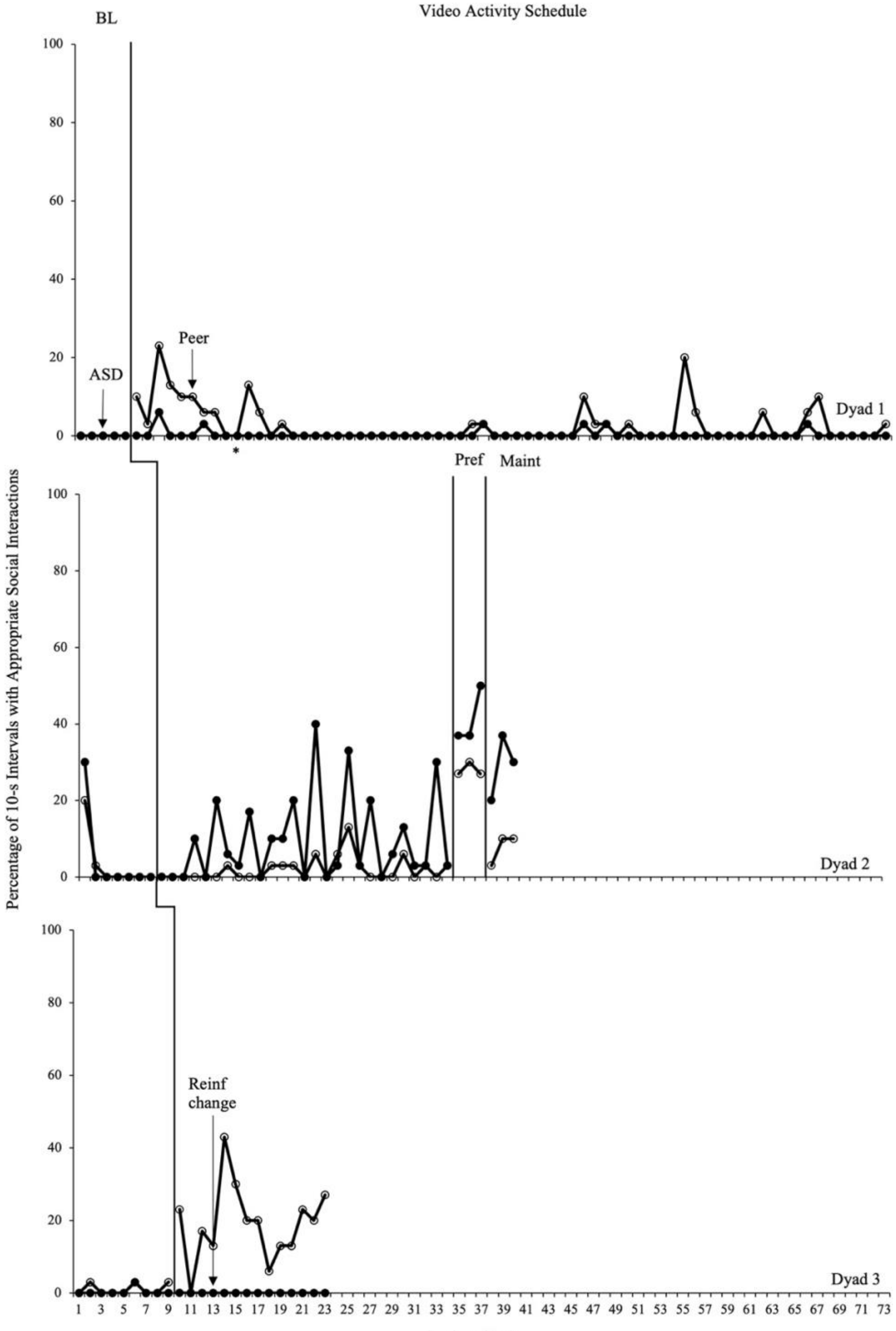

Figure 11. Percentage of 10 s intervals with appropriate social interactions for each participant dyad. Closed circles represent the participant with ASD and open circles represent the peer participant. The (*) denotes a booster session occurred prior to that session.

Effect Size

The Tau-*U* effect size for the tertiary dependent variable across all participants with ASD was 0.16, $p = .288$, indicating a small nonsignificant change. The effect size across all participants, including the peer, was 0.30, $p < .05$, indicating a moderate change. The same phases were applied to this calculation as the previous dependent variables.

Child with ASD's Preference for Video Activity Schedules

Figure 10 displays the results of the child preference phase for Tristan. He chose to use the video activity schedules in all three of the sessions.

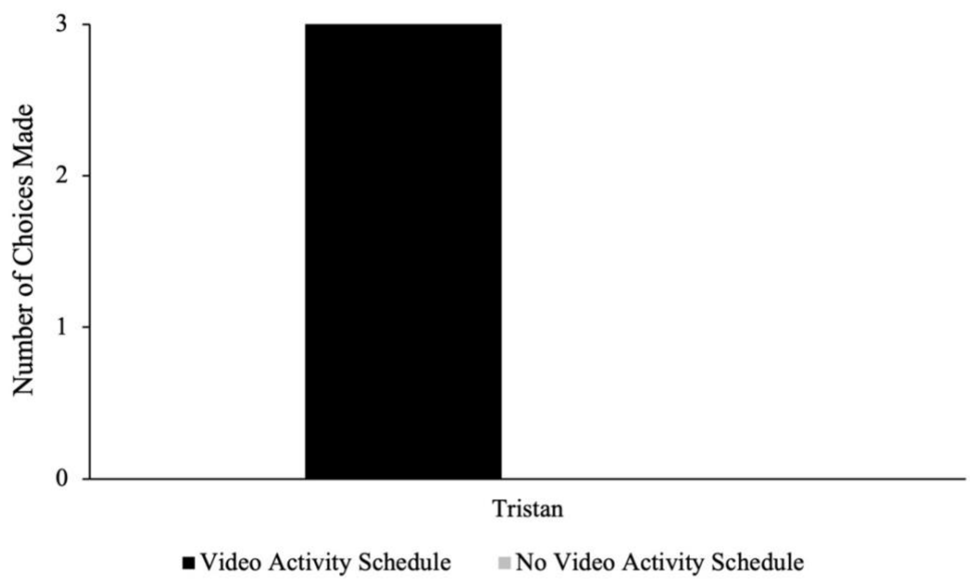

Figure 12. Number of times Tristan chose to use the video activity schedule to complete the activity across three sessions.

Social Validity

Table 8 contains the results of the social validity measure taken from Ray's teacher. Each item could have been rated as a "1" indicating strongly disagree, "2" disagree, "3" somewhat disagree, "4" somewhat agree, "5" agree, and "6" strongly disagree. The total score of the scale could range from 15-90 with a higher score indicating greater acceptability. Ray's teacher scored each item with a 6 providing a total score of 90, indicating her belief that she strongly agreed with the acceptability of the intervention. However, she told the researcher that she thought it seemed more effective when he used it to do the activity by himself.

Table 8

Social Validity Scale Results

Item	Rating
1. This was an acceptable intervention for the child's needs.	6
2. Most teachers would find this intervention appropriate for children with similar needs.	6
3. This intervention proved effective in supporting the child's needs.	6
4. I would suggest the use of this intervention to other teachers.	6
5. The child's needs were severe enough to warrant use of this intervention.	6
6. Most teachers would find this intervention suitable for the needs of this child.	6
7. I would be willing to use this intervention in the classroom setting.	6
8. This intervention did *not* result in negative side effects for the child.	6
9. This intervention would be appropriate for a variety of children.	6
10. This intervention was consistent with those I have used in classroom settings.	6
11. The intervention was a fair way to handle the child's needs.	6
12. This intervention was reasonable for the needs of the child.	6
13. I liked the procedures used in this intervention.	6
14. This intervention was a good way to handle this child's needs.	6
15. Overall, this intervention was beneficial for the child.	6

During the post-intervention interview, Ben indicated that he did not like the video activity schedule because the schedule slowed down the pace of the activity; however, he did appreciate that the video models showed him the required behaviors. Ben also indicated that the intervention helped him and Ray complete the activity correctly. Arnav stated that he liked the video activity schedules because he enjoys visual models of skills he is learning. Like Ben, he believed that the intervention was helpful to complete the activity correctly. Tristan's peer, Felix, said that he did not really like the video activity schedule because the schedule slowed down the pace of the activity. He reported that the videos were helpful and "cool", however, his preferred method of problem solving does not align with the strategy presented in the videos (i.e., he prefers covert problem-solving strategies). However, he did acknowledge that the video activity schedule did help them, particularly Tristan, complete the activity correctly. Joshua did not wish to participate in the interview.

CHAPTER FIVE

Discussion

The purpose of this study was to evaluate the effects of using a video activity schedule to support academic learning for children with ASD and typically developing peers during math center activities. Three children with ASD and four typically developing peers participated in this study. During baseline, all three children with ASD demonstrated low levels of performance with all three dependent variables. Their peers primarily ranged from moderate to high accuracy with completing the activity, moderate to high levels of on-task behavior, and low levels of appropriate socializations. Each participant was then trained on how to use the video activity schedule in the *Choiceworks*® application using mastered tasks. The intervention consisted of a video activity schedule, which was a series of video model segments that depicted how to complete the activity. Additionally, participants were prompted if they made an error or did not initiate a step within 5 s. During intervention, both participants with ASD and their peers showed an increase in the number of activity steps completed independently and correctly from baseline; however, they all displayed variable responding throughout the intervention phase. In addition, on-task behavior improved for all participants with ASD and to a lesser extent socialization improved for one of the participants with ASD. Despite the positive increases from baseline for all participants, Tristan was the only participant with ASD to meet mastery criteria with the original intervention procedures; therefore, more discussion is warranted. This chapter will focus on the conclusions that can be drawn from the results as they relate to the initial research questions and the broader video activity schedule literature. The limitations of the experimental study will also be discussed, as well as directions for future research.

Accurate Activity Completion

Overall, video activity schedules improved math activity completion (i.e., number of steps completed independently and correctly) for all participants with ASD and peers compared to baseline performance. However, all participants' data were variable, which indicates that they were unable to reach or sustain a high level of performance. This variability was most notable for Ray whose performance was significantly lower when his peer was responsible for the materials (see Figure 7). Many of the steps he performed incorrectly were the steps right after his peer rolled the dice, which were select and place the corresponding number of base-10 blocks on the place value mat. It is possible that his lack of physical contact with the programed stimuli negatively impacted the extent to which the stimuli evoked appropriate responding. According to Dinsmoor (1985) if the learner can observe and attend to the relevant stimuli there will likely be an enhancement of stimulus control. The lack of an observing response (i.e., physically contacting the stimuli) may have decreased the saliency of the dice which resulted in failure to engage in the next response. That is, because Ray did not have physical contact with the stimuli, they failed to evoke the target responses. When we altered sessions such that he completed an independent rather than cooperative activity schedule, we observed an increasing trend in correct responding. He met mastery criteria within five sessions. It is possible that once Ray mastered the activity individually the cooperative schedule may have produced more promising results. However, due to the end of the school year we were unable to evaluate this possibility.

Researchers investigating the use of video modeling and visual supports have applied the interventions individually and with multiple learners with mixed results when applied to more than one person. For example, Dueñas et al. (2019) evaluated the use of joint video modeling to promote play behavior for young children with ASD interacting with typically developing peers. During intervention, both the typically developing peer and child with ASD watched a 30 s video model of the expected play actions and script. While an increase in percentage of scripted responses was observed for all participants, only one of the three participants reached mastery criteria (i.e., 75%) and all had variable data. In contrast, previous researchers found that a similar procedure was effective in increasing appropriate play between children with ASD and their peers for all participants (see MacDonald et al., 2009), which may indicate that joint video-based interventions are more effective for some children with ASD than others. Tristan's performance resembled the performance of many participants within the video activity schedule literature in that his correct responding improved significantly from baseline and he was able to meet mastery criteria (see Spriggs et al., 2015; Kellems et al., 2016; Weng & Bouck, 2014). He engaged in high levels of on-task behavior which included attending to the relevant stimuli (i.e., iPad® and activity materials).

Simon's activity completion was notably lower than the other two participants. He was the only participant who was not able to demonstrate mastery criteria with the technology training phase. However, he consistently watched and imitated the videos at nearly 100% accuracy. Therefore, the decision to introduce intervention was made as we anticipated that the schedule following behaviors (i.e., selecting and swiping icons) would not greatly impede mastery of the math skill. Across the video activity schedule literature there are a variety of ways in which participants are taught to follow the activity schedule. However, the two most common discovered through the literature review in Chapter Two were: (a) procedures similar to the current study (i.e., training the participants before introducing intervention), or (b) providing continuous prompting throughout without training ahead of time. We noticed that, typically, if the study included a pretraining phase, they did not include steps involving manipulating the technology as part of their task analysis (e.g., Shepley et al., 2018). Perhaps if the participant was proficient at using the technology independently, they would not require prompting. Since the video activity schedule serves a self-directed prompt for the participant, it could be assumed that any additional prompting needed would be directly related to the behaviors that were modeled in the video; however, this was not the case for Simon. He often required prompts to engage in technology related behaviors (i.e., correctly selecting and swiping icons), in addition to the activity related behaviors. According to his IEP, Simon's teachers use physical prompting with him at school. It is possible that because of his extensive experience with physical prompts, the video prompts failed to evoke correct responding without contingent reinforcement or exposure to more learning opportunities. This pattern of responding is not unlike other participants included in the broader video activity schedule literature base. Many studies have compared the use of video activity schedules to a system of prompts with results that indicated some learners respond better to traditional prompting rather than video prompts (see Aljehany & Bennett, 2020; Kellems et al., 2016), or that participants required more intervention sessions to reach mastery (see Carrero &Fuller, 2019).

We did see improvement in Simon's accuracy after the schedule of reinforcement was changed from a noncontingent time-based schedule (i.e., after the 5-m session) to contingent on prompted or unprompted responses. He began to independently roll the dice and place the dice on the corresponding spot of the addition sentence visual. Rolling dice and matching colors were skills that he had in his repertoire according to his IEP. Despite these improvements, Simon continued to need prompts to use his device to say the number the dice landed on, count the correct number of Unifix cubes, identify the appropriate number and dot on his paper, and mark the dot with his dotting marker. It could be hypothesized that his inability to engage in some of these skills are attributed to his fine motor skills deficits, or a lack of history in discriminating visual stimuli from a larger array. As noted previously, it is possible that continued exposure to the video activity schedule would have resulted in mastery, however, he was unable to continue attending sessions.

As discussed previously, activity schedules sequence a chain of behaviors that the individual is to engage in using visual cues (i.e., pictures). This can be a series of activities (e.g., make bed, brush teeth, eat breakfast), or a series of steps within a single activity (e.g., turn on water, place hands under the running water, pump soap onto hands, etc.). Activity schedules have been used to address skill acquisition (i.e., learn a new behavior) and/or independence by increasing on-task or on-schedule behavior with skills that have already been acquired. For example, Becerra et al. (2021) used a picture-based activity schedule provided in a three-ring binder to teach three young children with ASD physical activity routines. All participants were fluent schedule at their preschool and did not engage in outdoor physical activity. Researchers measured three variables: (a) the percentage of intervals with engagement in the activity, (b) the percentage of intervals with on-schedule behavior, and (c) the number of activities the participants were able to complete. Researchers used a most-to-least prompting hierarchy to teach the participants to engage in the activity routine. All participants increased their physical activity engagement from baseline. Additionally, both approaches (i.e., skill acquisition and independence with mastered activities) have been used successfully in individual and group arrangements (see Akers, et al., 2018; Brodhead et al., 2014). The current literature indicates that activity schedules are primarily being used to teach activity independence by following a schedule in a three-ring binder (Knight et al., 2015). Conversely, video activity schedules, which replace the pictures with video models delivered on an electronic device, are primarily being used for skill acquisition of an individual activity (see Chapter Two of this dissertation). The contrast of these two approaches may be explained by the ability of video models to show more complex behaviors that stagnant pictures may not be able to do.

On-task Behavior

The introduction of video activity schedules increased on-task behavior for all participants. Both Tristan and his peer had the highest and most stable levels of on-task behavior. Sessions in which Tristan was not on task were attributed to a misunderstanding about the activity; however, he was able to recover his performance in subsequent sessions. A positive correlation between the change in the schedule of reinforcement delivery and Simon's on-task behavior was observed. That is, when reinforcers were provided noncontingently (i.e., time-based at the end of the session), he was on task for an average of 75% of the intervals. When reinforcers were provided contingent on prompted and unprompted responses, he was on task for an average of 90% of intervals.

The definition of on-task behavior included the participants appropriate engagement with the activity materials according to the task analysis, including attempting to engage with the activity correctly, attending to the videos while they were being played, navigating the video activity schedule (i.e., pressing play or swiping), and following the researcher's directions. While we feel this definition truly captures being on task, there were many behaviors that the participants could have engaged in to meet the definition. This could have attributed to the magnitude in change compared to baseline for all participants where they were essentially allowed to do nothing. This may also be why we see a difference in the results of the primary and secondary dependent variables. If the participant did not engage in the step correctly and required prompting but responded appropriately to the prompting, this was counted as an error for the primary dependent variable but likely was counted as on task for the secondary dependent variable. That is, even if the participant was not engaging in the steps correctly, if they were trying to engage in the materials correctly and/or engaged correctly after a prompt was given, they were on task. These differences are most noteworthy for Ray and Simon who had the lowest or most inconsistent performance with their activity but maintained moderate to high levels of on-task behavior during the intervention phases. There may be times within the school day that teachers are more concerned with a student's ability to independently engage in activities and less concerned with whether they completed the activity correctly. Learning centers are typically a time when students get to independently practice skills that they have either mastered or have at least been initially instructed on while the teacher provides small group instruction. During this time, teachers may be more concerned with students being on task so they can devote their time to the small group rather than managing problem behavior that may occur due to lack of on-task behavior.

Visual inspection of the data for Dyad 3 show that the on-task behavior between Simon and Joshua were highly related to who was responsible for the iPad® and activity materials. Meaning, when Simon was responsible for the materials, Simon spent more time on task and Joshua spent less time on task. In contrast, when Joshua was responsible for the materials, Joshua spent more time on task and Simon spent less time on task. This was true 79% of the sessions, while 7% of sessions indicated that both Simon and Joshua were equally on task. For Ray and his peers this was observed in 56% of the sessions, while 12% indicated both participants were equally on task. As discussed previously, to some degree, on-task behavior may be related to activity completion. If neither dyad participant was attending properly to the relevant activity stimuli, particularly when the other was responsible for the materials, completing additional steps within the activity or manipulating the technology (i.e., on-task behavior) may be less likely to occur. For example, Ledbetter-Cho et al. (2020) collected data on specifically on stereotypy and challenging behavior as a dependent variable in their video activity schedule study related to math tasks for young children with ASD. They found that video activity schedules decreased these collateral behaviors to some extent for all participants. While the current study did not collect data on engagement in stereotypy or challenging behavior, both Ray and Simon engaged in these behaviors and these behaviors are captured to some extent in the definition of on-task behavior. That is, if the participant was observed to be engaging in motor stereotypy such as jumping up and down repeatedly, or challenging behavior such as elopement from the table this was incompatible with engaging with the materials and completing the activity, thus this was recorded as off-task. Additionally, the three studies included in the review from Chapter Two that collected data on on-task or on-schedule behavior (see Dauphin et al., 2004; Thomas et al, 2020; Torres et al., 2018) indicated that all participants improved from baseline with most performing at a level similar to the participants with ASD in the current study. Since this is the first study to evaluate the video activity schedule as a joint intervention rather than an individual intervention, differences across participant dyads, or even within the dyad may be related to the inclusion of a peer and how their behavior may in turn affect the child with ASD.

Appropriate Socializations

Of the three dependent variables, video activity schedules had the least impact on appropriate socializations for the participants with ASD. Specifically, for Ray and Simon, they did not engage in any vocal verbal communication either through vocal speech, or with a device in the case of Simon. Both instances in which Ray and Simon were observed to engage in a response that met the definition came from nonvocal verbal behaviors such as accepting an item from a peer or tapping a peer on the arm. Anecdotal reports from the teacher, paraprofessionals, and ABA therapist all indicated that Ray rarely initiates social interactions with his peers and prefers to engage in his preferred activities when given the opportunity rather than seek out his peers. Unlike the two other participants who engage in vocal verbal communication, Simon uses an AAC device to communicate. Throughout the study, he used his device to independently mand (i.e., request) for edibles, to use the bathroom, to see his mother, or to play. Generally, in ABA, the focus is to first teach the individual to mand to reinforce communication before extending to other areas of verbal behavior such as tacting (i.e., labeling), or intraverbals (e.g., conversation; Barbera, 2007). As assessing or reinforcing communication was outside of the scope of this study, it is unclear as to whether Simon was capable of independently making comments or responding to his peer during the activity with his device. Further, he did not engage in any nonverbal responses such as nodding or shaking his head, or high fiving his peer during intervention.

The activity schedule literature base has evaluated the use of traditional, picture-based activity schedules with peers to increase play, on-task or on-schedule behavior, and socialization. Joint activity schedules refer to schedules in which one picture-based activity schedule is used to display the sequence of activities simultaneously to a pair or group of individuals (Betz et al., 2008). Gadaire et al. (2018) used joint activity schedules to increase social engagement between small groups of children with ASD. The children followed the joint activity schedule to play three close-ended activities together. On-task behavior and social engagement increased for all children compared to baseline and showed that children preferred the use of joint activity schedules compared to therapist delivered prompts. Linked activity schedules include social scripts to prompt social imitations and responses and are arranged such that the action of one child depends on the other for both children to advance further in their schedule (Higbee & Brodhead, 2016). For example, Brodhead et al. (2014), used a linked activity schedule to teach young children with ASD to play hide and seek with one another. They used two picture-based activity schedules in binders, one for the role of the hider and one for the role of the seeker. In addition to the pictures providing the sequence of the game (e.g., picture of a hiding spot, a counting to 20 visual), the schedule contained scripts for the children to say as either the hider or seeker (e.g., “Oh no!”, “Go hide”, “I found you”). The linked activity schedule improved game play and socialization for all three dyads. Joint and linked activity schedules have been used for play and socialization in subsequent studies with equal success and have even demonstrated that children with ASD prefer to engage socially with peers following their use (Akers et al., 2018; Gadaire et al., 2020; Pellegrino, 2018). Perhaps programmed social interactions within the video activity schedule may have resulted in increased social interactions for Simon and Ray as was evident for the participants in these studies.

Tristan engaged in numerous social interactions during the intervention phase; however, he also demonstrated this skill during baseline, albeit for only one session. Social skills were not directly assessed in the current study prior to sessions beginning; however, Tristan was the only participant to be educated fully in a general education classroom with minimal support. Therefore, it could be hypothesized that Tristan receives more opportunities to engage with his peers than the other two participants. Despite Ray’s participation in a general education classroom, he was often observed engaging in independent activities with or without his ABA therapist rather than engaging with his peers. Tristan and Felix’s social interactions further increased during the child preference phase when they had unplanned time off from the research study prior to those sessions occurring. It may be that the sessions and the social interactions between the two had become reinforcing. Therefore, the time spent apart created a state of deprivation, and thus, altered the value of these interactions such that an increase was observed when they were reunited. They were observed making encouraging comments (e.g., "You're doing good"), making jokes and laughing, and helping each other with the activity (e.g., checking their work with what the other peer did).

Social Validity

According to the IRP-15 results, Ray's teacher strongly favored the use of video activity schedules to support Ray to complete math center activities. However, she noted that she thought he was more successful when he was engaging in the activity independently. This indicates that despite having variable data in the primary and secondary dependent variables, the teacher saw value in using the intervention to help Ray participate more in the classroom. Additionally, she told the researcher that it would be interesting to see the intervention applied to other activities either as an independent or cooperative activity.

While the teacher provided positive feedback regarding the video activity schedules, mixed feedback was given from the peers. Ben and Arnav acknowledged and liked that the intervention helped them complete the activity. However, they did not prefer using the schedule as it tended to slow the pace of the activity. They also told the researcher numerous times throughout the study, particularly after the first couple of weeks, that they did not need the videos to do the activity. As stated previously, Ray's peers seemed to have been fatigued from the duration of the study and this could have attributed to some of their opinions about the intervention. This intervention may be better suited for situations in which the activity can regularly alternate (e.g., math activities rotate weekly). Within the current study, this was not possible as it would have weakened experimental control. Based on the positive reports related to watching the videos, it is possible that the intervention may be more preferred in a typical classroom structure rather than a tightly controlled research study. Felix expressed similar opinions in that he felt the intervention decreased the speed in which the activity could be completed. Therefore, it may be that for video activity schedules to be not only effective but preferred for an academic cooperative activity, both students should be working at a similar level with modeled strategies both students benefit from.

We were only able to assess preference with Tristan. Across all three sessions, he chose to use the video activity schedule. This indicated that he had a strong preference for using it, as he never deviated from this choice. While we only interviewed Felix, Tristan was present and provided anecdotal information such as “I like the iPad®” and “I like to watch videos on YouTube™”. The preference for use of the video activity schedules aligns with Gadaire et al. (2018) where they also found that children with ASD preferred a joint activity schedule to help them interact and play with their peers.

Limitations

This study has a few limitations worth noting. First, due to the COVID-19 pandemic, not all participants in this study were in a school setting as intended. Despite having typically developing peers participate with those who were not in a school setting, being in a controlled environment like the university-based center likely impacted the findings for Tristan and Simon. The biggest difference between the classroom and university-based center was the additional environmental variables and distractions present in the classroom. During sessions, the teacher held small group instruction while the other students worked in pairs or individually to complete math centers. While the teacher had general classroom behavior management strategies in place (e.g., digital group contingencies), the noise level in the classroom was above conversational on a regular basis. Other typical events during sessions included announcements from the front office, support teachers (e.g., math or reading specialist) coming in and out of the classroom to talk with the teacher or students, school administrators correcting inappropriate student behavior, and having a substitute teacher for the day. All these variables may have affected Ray and his peers' performance during the study to some degree; however, these are all common events within any classroom in schools.

Simon's time was limited due to scheduling conflicts throughout the study. Perhaps with more time, we could have continued with technology training to ensure that he was fluent with navigating the video activity schedule. Mastery of technology training may have reduced the amount of prompting that he received within the 5 min session and provided more opportunities to engage in steps in the activity. While his data demonstrated an increasing trend, particularly when he was responsible for the materials, this was correlated with the change in procedures to provide contingent reinforcement for prompted and unprompted responses. This could be attributed to the change or may be attributed to continued exposure to interventions sessions. The broader video activity schedule literature base demonstrates that for some participants, particularly those with extensive support needs, they may need more time to demonstrate proficiency (Shepley et al., 2018; Thomas et al., 2020).

We did not evaluate prerequisite skills and instead used skills that the teacher or parent identified as the participant with ASD having but were going to be built upon in an upcoming unit of study in class, or in the child's IEP goal. Anecdotally, Tristan and Simon made errors that could be attributed to prerequisite skills that could have been addressed prior to the study. For example, Tristan occasionally skip counted by fives incorrectly (e.g., 20, 25, 40, 45...) which was an incorrect response on his task analysis (i.e., Step 9). Simon had difficulty counting Unifix cubes to represent the number rolled on the dice, despite his IEP indicating that he could count sets up to 10. This could be attributed to his fine motor skills deficits and may be assessed and taught differently at school (i.e., visuals on paper that he points to rather than concrete manipulatives); however, this information was not relayed to the researcher to adapt the activity to better fit his current repertoire. In other academic related video activity schedule studies, the researchers were able to include teachers or staff during planning and implementation and/or assess prerequisite skills (Dueker & Canella-Malone, 2019; Knight et al., 2018; Ledbetter-Cho et al., 2020). Perhaps directly assessing prerequisite skills or being able to speak directly to Simon and Tristan's teachers may have produced different outcomes.

Directions for Future Research

Many of the traditional picture-based activity schedule studies require participants to be fluent activity schedule followers. That is, they expect a minimum of 80% independence (Brodhead et al., 204). However, the video activity schedules literature typically requires that the participants have no previous experience with video activity schedules or video modeling. It is uncertain as to why these two approaches differ considering their similarities. The current study and numerous other studies try to address video activity schedule fluency through technology training. However, as was the case for Simon, mastery or fluency was not able to be reached, and other research studies have shown that some participants require more training sessions than others. Therefore, future researchers could adapt their protocol to ensure fluency outside of the study as much of the picture-based activity schedule does, thus, ensuring that prompts are related to skill acquisition of the activity rather than use of the intervention itself. This will likely increase independence and produce a more socially valid intervention. Similarly, Simon and to a lesser degree, Tristan, were observed making errors related to prerequisite skills needed to complete steps within their respective math activities. For Simon, one of these skills was being able to discriminate from a large array in order to identify the sum of the addition sentence, while Tristan made errors with skip counting by fives in order to count the total value of the coins. It may be that these prerequisite skills should be taught to fluency prior to introducing the video activity schedule, or at least be embedded within the procedures as needed. Canella-Malone et al. (2018) experienced a similar occurrence with their participant, Peter, who was using a within-activity video activity schedule to make lemonade. Due to Peter’s fine motor skills deficits, he was unable to independently stir the lemonade. Therefore, the researchers introduced additional procedures to include mass practice trials to ensure Peter was fluent with this skill before proceeding further. Future research could evaluate to what extent training prerequisite skills is needed when teaching a skill using video activity schedules.

As discussed previously, much of the joint picture-based activity schedule literature has been successful in improving child outcomes that were similar to the ones evaluated in the current study. However, the results of the current study differ from those studies. There may be a few explanations worth discovering. First, the picture-based activity schedules are often across activity schedules (Gadaire et al., 2018) while the current study used a within-activity schedule. Generally, picture-based across activity schedules teach schedule following using activities the individuals know how to do independently but are providing opportunities for the learner to engage in these activities for an extended period either individually or in groups. The video activity schedule literature on the other hand has typically focused on activities the learner does not know how to do independently. Furthermore, the complexity of some components of the activities assessed in the current study such as longer chains of behavior and attending to relevant stimuli that the learner did not have physical contact with may indicate that for academic activities, joint video activity schedules may not be suitable. Future research should evaluate under what contexts individual versus joint video activity schedules improve outcomes for the learner and promote independence. Lastly, the attending differences between video activity schedules and picture-based activity schedules may be notably different. We observed inconsistencies across two of the three participants with their ability to attend to the video activity schedule and relevant activity stimuli. The picture-based activity schedule literature indicates that on-task or on-schedule behavior increases and typically sustains during their use. Future research could look at comparing how the two interventions improve these outcomes for a similar area of focus (e.g., play or academic activities).

Considering the success linked activity schedules have in improving socialization for children with ASD and their peers, future research should extend this area to video activity schedules. The results of the literature review from Chapter Two indicate that two studies (Babb et al., 2018; Babb et al., 2020) use within-activity video activity schedules and embedded social scripts when teaching vocational skills to adolescents with ASD. For example, in Babb et al. (2018), one of the video prompts modeled an individual approaching the library supervisor, then a "hot spot" (i.e., script) appeared on the screen, the learner selected the hot spot and listened to recorded phrase, (i.e., "Can you check my work?"). The learner was then required to emit the script and wait for a response from the supervisor before moving to the next video and step in the sequence. Results of the study indicated that the participants were able to significantly increase their performance with the task and engage in socialization with other individuals in the workplace. However, these studies provide minimal opportunities for social engagement with another individual. Future research should look at using linked video activity schedules for play or academic activities in schools where children with ASD frequently encounter peers and opportunities to socially engage with one another. Many schools use technology such as tablets, thus a video activity schedule rather than a picture-based schedule may be more appropriate and occasion less stigmatization for the child with ASD.

Finally, while this study adds to the literature regarding use of video activity schedules to support academic learning, the literature in this area is minimal. Future research should continue to evaluate this intervention to support learners with ASD and other developmental disorders in other academic areas. For example, Sartini et al. (2020)

and Knight et al. (2018) were the only studies to focus on an area other than a science, technology, engineering, or math (STEM). Specifically, Sartini et al. (2020) focused solely on reading comprehension, and Knight et al. (2018) had one participant learn to write their full name. To best understand which academic content areas (e.g., reading, writing, math, science, history) are better suited for video activity schedules, future research should continue to address academic areas beyond STEM. Additionally, future research could investigate how teachers would prefer to use video activity schedules. As stated previously, they have been used for both skill acquisition and skill maintenance or on-task behavior focused, and they have been taught to teach a variety of skills, with less research related to academics compared to daily living skills. Therefore, researchers should look at assessing under what contexts do teachers find value in using the video activity schedules for their students with ASD. Conducting this qualitative research will inform where single-case design researchers focus their efforts to best serve not only the participants with ASD but ensure that teachers use these interventions and reduce the research to practice gap.

Conclusion

The current study evaluated the effects of using a video activity schedule to support young children with ASD during math center activities with a peer. To the researcher's best knowledge, this is the first study to include video activity schedules as a joint intervention rather than an individual intervention, including use of typically developing peers, and only the second to be assessed in general education classrooms. Results indicated that video activity schedules did improve activity completion and on-task behavior for most of the participants when compared to baseline. However, the observed variability of Ray's data indicates that for some students, application of video activity schedules as an independent intervention may need to be applied first before trying as a joint intervention. Additionally, prerequisite skills may need to be addressed before including an academic skill in a video activity schedule. Due to only being able to conduct this study in a general education class for one rather than all three participants, further research in this area is warranted.

APPENDICES

APPENDIX A

Data Sheets

Table A.1

Primary Dependent Variable for Dyad 1

Step	Opp. 1	Opp. 2	Opp. 3	Opp. 4	Opp. 5	Opp. 6	Opp. 7
1. Pick up and roll the red dice to show how many hundreds to build							
2. Select and place the matching number of hundreds on the place value mat							
3. Pick up and roll the yellow dice to show how many tens to build							
4. Select and place the matching number of tens on the place value mat							
5. Pick up and roll the blue dice to show how many ones to build							
6. Select and place the matching number of ones on the place value mat							
7. Write the value of the number on the first column of the recording sheet (e.g., 1 hundred, 4 tens, 8 ones)							
8. Write the expanded form of the number on the second column of the recording sheet (e.g., 100 + 40 + 8)							
9. Write the standard form of the number on the third column of the recording sheet (e.g., 148)							
10. Clear the base ten blocks off the place value mat and put the blocks back							

Number of steps completed correctly: _____ / ______ * 100 = ______%

Table A.2

Primary Dependent Variable for Dyad 2

Step	Card 1	Card 2	Card 3	Card 4	Card 5	Card 6	Card 7
1. Pick one task card from the pile							
2. Read the task card aloud							
3. Pick the correct coins							
4. Place the coins on the correct column of the coin mat							
5. Say aloud the value of each type of coin on the coin mat							
6. Draw five tally marks on the recording sheet for each quarter (e.g., 2 quarters = 10 tally marks)							
7. Draw two tally marks on the recording sheet for each dime (e.g., 4 dimes = 8 tally marks)							
8. Draw one tally mark on the recording sheet for each nickel (e.g., 7 nickels = 7 tally marks)							
9. Count aloud by fives for each tally mark on the recording sheet							
10. Then, count on aloud by ones for each penny							
11. Write the number on the recording sheet							
12. Clear the coins off the math and put the coins back in the pile							
13. Put the card in the finished pile							

Number of steps completed correctly: _____ / ______ *100: _____%

Table A.3

Primary Dependent Variable for Dyad 3

Step	Opp. 1	Opp. 2	Opp. 3	Opp. 4	Opp. 5	Opp. 6	Opp. 7
1. Roll the red dice							
2. Read the number aloud using vocal speech or SGD							
3. Place the dice on the first spot on the addition sentence							
4. Count out the matching number of Unifix cubes							
5. Roll the yellow dice							
6. Read the number aloud using vocal speech or SGD							
7. Place the dice on the second spot on the addition sentence							
8. Count out the matching number of Unifix cubes							
9. Count all the Unifix cubes together to get the sum							
10. Dot the matching number on the recording sheet							
11. Put the Unifix cubes and dice back							

Note. SGD speech generating device

Number of steps completed correctly: _____ / ______ *100: _____%

Table A.4

Secondary Dependent Variable

Operational Definition:

- Manipulating or engaging with task materials in the manner that they were intended (e.g., engaging in the targeted step, placing materials on chart)
- Looking at the iPad to watch the video model segment (Note: Continuing to look at the iPad for more than 5 s after the video has stopped or trying to leave the app or video prior to the activity being complete will not count as being on-task)
- Following the directions provided by the voice-over narration in the video activity schedule, or following the directions provided by the researchers
- Sitting or standing in the activity area waiting for peer to complete step *(Note: Talking to other children in the class or research team members about topics not related to the activity <u>does not</u> count as being on-task)*

0:00-0:09	0:10-0:19	0:20-0:29	0:30-0:39	0:40-0:49	0:50-0:59
1:00-1:09	1:10-1:19	1:20-1:29	1:30-1:39	1:40-1:49	1:50-1:59
2:00-2:09	2:10-2:19	2:20-2:29	2:30-2:39	2:40-2:49	2:50-2:59
3:00-3:09	3:10-3:19	3:20-3:29	3:30-3:39	3:40-3:49	3:50-3:59
4:00-4:09	4:10-4:19	4:20-4:29	4:30-4:39	4:40-4:49	4:50-4:59

Participant with ASD: ____ / 30 * 100 = _____%

Peer Participant: ____ / 30 * 100 = _____%

Table A.5

Tertiary Dependent Variable

Operational Definition:

- Verbal, physical, or gestural initiations or response to a peer (e.g., tapping the peer on the shoulder, giving an item to a peer, or receiving an item from a peer)
- Making a statement or asking a question about the activity or relative to the conversation
- Responding to a peer's statement or question with an on-topic statement
- Making a physical gesture like shaking the head in disagreement or giving a thumbs up.

0:00-0:09	0:10-0:19	0:20-0:29	0:30-0:39	0:40-0:49	0:50-0:59
1:00-1:09	1:10-1:19	1:20-1:29	1:30-1:39	1:40-1:49	1:50-1:59
2:00-2:09	2:10-2:19	2:20-2:29	2:30-2:39	2:40-2:49	2:50-2:59
3:00-3:09	3:10-3:19	3:20-3:29	3:30-3:39	3:40-3:49	3:50-3:59
4:00-4:09	4:10-4:19	4:20-4:29	4:30-4:39	4:40-4:49	4:50-4:59

Participant with ASD: ____ / 30 * 100 = _____%

Peer Participant: ____ / 30 * 100 = _____%

Table A.6

Technology Training for Dyad 1, Dyad 2, and Joshua

Step	+ / - / NA
1. Select the "1" icon	
2. Watch the video	
3. Follow the video: pick up three red dinosaurs and put them in the red bowl	
4. Move the "1" icon to All Done	
5. Select the "2" icon	
6. Watch the video	
7. Follow the video: pick up three blue dinosaurs and put them in the blue bowl	
8. Move the "2" icon to All Done	
9. Select the "3" icon	
10. Watch the video	
11. Follow the video: pick up three yellow dinosaurs and put them in the yellow bowl	
12. Move the "3" icon to All Done	
13. Select the "4" icon	
14. Watch the video	
15. Follow the video: pick up three purple dinosaurs and put them in the purple bowl	
16. Move the "4" icon to All Done	
17. Select the "5" icon	
18. Watch the video	
19. Follow the video: pick up three green dinosaurs and put them in the green bowl	
20. Move the "5" icon to All Done	
21. Select the "6" icon	
22. Watch the video	
23. Follow the video: pick up three orange dinosaurs and put them in the orange bowl	
24. Move the "6" icon to All Done	
25. Push "Reset" in the top right corner	
26. Push "Reset" in the pop up	

Number of steps completed correctly: _____/ 26 *100: _____%

Table A.7

Technology Training for Simon

Step	+ / - / NA
1. Select the “1” icon	
2. Watch the video	
3. Follow the video: pick up the green dinosaur and put it in the green bowl	
4. Move the “1” icon to All Done	
5. Select the “2” icon	
6. Watch the video	
7. Follow the video: stack the blocks on top of each other	
8. Move the “2” icon to All Done	
9. Select the “3” icon	
10. Watch the video	
11. Follow the video: match letter A	
12. Move the “3” icon to All Done	
13. Select the “4” icon	
14. Watch the video	
15. Follow the video: finish the puzzle	
16. Move the “4” icon to All Done	
17. Push “Reset” in the top right corner	
18. Push “Reset” in the pop up	

Number of steps completed correctly: _____/ 18 *100: _____%

APPENDIX B

Procedural Fidelity Checklists

Table B.1

Baseline Checklist

Researcher Step	Yes/No	
1. The researcher gave directions on the activity to be completed: "You're going to do the [NAME OF ACTIVITY] activity. I'm not going to help you right now, so just try your best to do the activity together with your partner."	Yes	No
2. The researcher provided the participants with the materials for the activity.	Yes	No
3. The researcher set a timer for 5 minutes.	Yes	No
4. The researcher did not provide any prompting to the participants on how to complete the tasks or to stay on task. *The teacher or staff may provide general praise or correction to students in the class, including participants, as they normally would but will not provide prompting on how to complete the activity.*	Yes	No

Number of steps completed correctly: _____ / 4 * 100 = _____%

Table B.2

Technology Training: Errorless Learning Session Checklist

Researcher Step	+ / - / NA
1. The researcher told the participant that they were going to learn how to use the video activity schedules on the iPad.	
2. The researcher gave the iPad to the participant with the application *Choiceworks* opened.	
3. The researcher provided a verbal cue (e.g., "Watch number one") and immediately prompted (i.e., physical prompt for participant with ASD, verbal prompt for peer) the participant to select the first video in the schedule.	
4. After the video ended, the researcher immediately prompted (i.e., physical prompt for participant with ASD, verbal prompt for peer) the participant to perform the step demonstrated in the video.	
5. After the participant completed the step, the researcher immediately prompted (i.e., physical prompt for participant with ASD, verbal prompt for peer) the participant to move the first video to the finished column.	
6. The researcher immediately prompted (i.e., physical prompt for participant with ASD, verbal prompt for peer) the participant to select the next video in the schedule.	
7. The researcher repeated steps 3-6 until all activities in the video activity schedule were completed.	
8. The researcher immediately prompted (i.e., physical prompt for participant with ASD, verbal prompt for peer) the participant to select "Reset" in the top right corner and press "Reset" again on the pop-up window	

Number of steps completed correctly: _____ / 8 * 100 = _____%

Table B.3

Technology Training: 2^{nd}+ Sessions Checklist

Researcher Step	+ / - / NA
1. The researcher gave the iPad to the participant with the application *Choiceworks* opened.	
2. The researcher provided a verbal cue about the activity (e.g., "Let's do your color sorting schedule").	
3. If the participant did not engage in the target behavior within 5 s, the researcher provided a prompt (i.e., verbal prompt for Ray, Tristan, and peers, physical prompt for Simon) to select the first video in the schedule.	
4. After the video ended, if the participant did not engage in the target behavior within 5 s, the researcher provided a prompt (i.e., verbal prompt for Ray, Tristan, and peers, physical prompt for Simon) to perform the step demonstrated in the video.	
5. When the participant completed the step, if the participant did not engage in the target behavior within 5 s, the researcher provided a prompt (i.e., verbal prompt for Ray, Tristan, and peers, physical prompt for Simon) to move the first video to the finished column.	
6. If the participant did not engage in the target behavior within 5 s, the researcher provided a prompt (i.e., verbal prompt for Ray, Tristan, and peers, physical prompt for Simon) to select the next video in the schedule.	
7. The researcher repeated steps 3-6 until the activity was completed.	
8. If the participant did not engage in the target behavior within 5 s, the researcher provided a prompt (i.e., verbal prompt for Ray, Tristan, and peers, physical prompt for Simon) to the participant to select "Reset" in the top right corner and press "Reset" again on the pop-up window	

Number of steps completed correctly: _____ / 8 * 100 = _____

Table B.4

Intervention Checklist

Researcher Step	+ / - / NA
1. The researcher provided the participants with the materials for the activity	
2. The researcher gave directions on the activity to be completed: "You're going to do the [NAME OF ACTIVITY] activity together with the iPad and video schedules to show you how to do it. [CHILD'S NAME] will be in charge of the iPad and then you'll take turns."	
3. The researcher gave the iPad to one of the participants.	
4. The researcher set a timer for 5 minutes.	
5. If the participant with ASD did not engage in the target behavior within 5 s or made an error, the researcher prompted the participant using a controlling prompt (i.e., verbal for Ray and Tristan, physical for Simon). If the peer participant did not engage in the target behavior within 5 s or made an error, the researcher provided a verbal prompt. *This may be repeated throughout the session.*	

Number of steps completed correctly: _____ / 5 * 100 = _____

Table B.5

Booster Session Checklist

Researcher Step	+ / - / NA
1. The researcher provided the participants with the materials for the activity	
2. The researcher gave directions on the activity to be completed: "You're going to do the [NAME OF ACTIVITY] activity together with the iPad and video schedules to show you how to do it. [PEER'S NAME] will be in charge of the iPad and dice this time."	
3. The researcher gave the iPad to one of the participants.	
4. The researcher instructed the participants to begin the activity and set a timer for 5 minutes.	
5. After the video has ended and the peer rolled the dice, the researcher immediately provided a verbal prompt to the participant with ASD (e.g., "PEER rolled a 5. You need 5 hundreds blocks.") and physically prompted them to pick up the corresponding number of hundreds blocks and place them on the chart. The researcher provided neutral praise.	
6. After the video has ended and the peer rolled the dice, the researcher immediately provided a verbal prompt to the participant with ASD (e.g., "PEER rolled a 3. You need 3 tens blocks.") and physically prompted them to pick up the corresponding number of tens blocks and place them on the chart. The researcher provided neutral praise.	
7. After the video has ended and the peer rolled the dice, the researcher immediately provided a verbal prompt to the participant with ASD (e.g., "PEER rolled a 6. You need 6 ones blocks.") and physically prompted them to pick up the corresponding number of ones blocks and place them on the chart. The researcher provided neutral praise.	
8. After the video has ended, the researcher immediately physically prompted the participant with ASD to pick up the pencil and write the corresponding number of hundreds, tens, and ones on their recording sheet. The researcher provided neutral praise.	
9. After the video has ended, the researcher immediately physically prompted the participant with ASD to pick up the pencil and write the expanded form of the number on the recording sheet. The researcher provided neutral praise.	
10. After the video has ended, the researcher immediately physically prompted the participant with ASD to pick up the pencil and write the standard form of the number on the recording sheet. The researcher provided neutral praise.	
11. After the video has ended, the researcher immediately physically prompted the participant with ASD to put the materials back. The researcher provided neutral praise.	

Number of steps completed correct: _____ / 11 * 100 = _____%

Table B.6

Child Preference Checklist

Researcher Step	+ / - / NA
1. The researcher provided the participants with the materials for the activity	
2. The researcher gave directions on the activity to be completed: "You're going to do the [NAME OF ACTIVITY] activity. But [NAME OF PARTICIPANT WITH ASD] is going to decide if you will do it with or without the iPad."	
3. The researcher asked the child with ASD whether they wanted to complete the activity with or without the iPad.	
4. The researcher provided the iPad to the child with ASD based on their preference.	
5. The researcher set a timer for 5 minutes.	
6. During the activity, if the participant with ASD did not engage in the target behavior within 5 s or made an error, the researcher prompted the participant using a least-to-most prompting hierarchy. During the activity, if the peer participant did not engage in the target behavior within 5 s or made an error, the researcher provided a verbal prompt. *This may be repeated throughout the session.*	

Number of steps completed correct: _____ / 6 * 100 = _____%

Table B.7

Maintenance Checklist

Researcher Step	+ / - / NA
1. The researcher provided the participants with the materials for the activity.	
2. The researcher gave directions on the activity to be completed (e.g., "You're going to do the [NAME OF ACTIVITY] activity").	
3. The researcher gave the iPad to one of the participants.	
4. The researcher set a timer for 5 minutes.	
5. The researcher did not provide any prompting to the participants on how to complete the tasks or to stay on task. *If participants are in the school, the teacher may provide general praise or correction to students in the class, including participants as they normally would but will not provide prompting on how to complete the activity.*	

Number of steps completed correct: _____ / 5 * 100 = _____%

APPENDIX C

Social Validity Scale

Table C.1

Modified IRP-15 Social Validity Scale

Item	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
1. This was an acceptable intervention for the child's needs.	1	2	3	4	5	6
2. Most teachers would find this intervention appropriate for children with similar needs.	1	2	3	4	5	6
3. This intervention proved effective in supporting the child's needs.	1	2	3	4	5	6
4. I would suggest the use of this intervention to other teachers.	1	2	3	4	5	6
5. The child's needs were severe enough to warrant use of this intervention.	1	2	3	4	5	6
6. Most teachers would find this intervention suitable for the needs of this child.	1	2	3	4	5	6
7. I would be willing to use this intervention in the classroom setting.	1	2	3	4	5	6
8. This intervention did *not* result in negative side effects for the child.	1	2	3	4	5	6
9. This intervention would be appropriate for a variety of children.	1	2	3	4	5	6

(Continued)

Modified IRP-15 Social Validity Scale (Continued)						
Item	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
10. This intervention was consistent with those I have used in classroom settings.	1	2	3	4	5	6
11. The intervention was a fair way to handle the child's needs.	1	2	3	4	5	6
12. This intervention was reasonable for the needs of the child.	1	2	3	4	5	6
13. I liked the procedures used in this intervention.	1	2	3	4	5	6
14. This intervention was a good way to handle this child's needs.	1	2	3	4	5	6
15. Overall, this intervention was beneficial for the child.	1	2	3	4	5	6

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