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UNIVERSITY OF NORTHERN COLORADO

Greeley, CO

The Graduate School

COMPARATIVE EFFECTS OF AN ELECTRONIC VISUAL ACTIVITY SCHEDULE ON YOUNG CHILDREN WITH AUTISM SPECTRUM DISORDER IN INCREASING INDEPENDENCE IN ACTIVITY TRANSITIONING

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Philosophy

Leisha LeAnn Tompkins

College of Education and Behavioral Sciences
Department of School Psychology
August 2019

This Dissertation by: Leisha LeAnn Tompkins

Entitled: *Comparative Effects of an Electronic Visual Activity Schedule on Young Children with Autism Spectrum Disorder in Increasing Independence in Activity Transitioning*

has been approved as meeting the requirement for the Degree of Doctor of Philosophy in College of Education and Behavioral Sciences in Department of School Psychology.

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ABSTRACT

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Young children with Autism Spectrum Disorder (ASD) often have difficulty transitioning from one activity to the next without verbal prompts from caregivers, but caregivers may not always be readily available. Binder-based visual schedules can be used to increase independence in transitioning but can be stigmatizing and cumbersome for the student. The purpose of the current study was to compare the effects of an iPad-based electronic visual to a traditional binder based visual activity schedule for elementary-aged children with ASD to increase independence activity completion and transition.

Data were collected using a single-subject, alternating treatment design (A-B-C-A-B-C) with three participants. Independent activity completion was defined as completing a four-activity sequence with one or fewer verbal prompts. The researcher also measured latency, or the duration (in seconds) between the initial verbal prompt instructing the students to complete their activity schedules and the student's behavior of beginning the activity. The researcher also collected data comparing a baseline measure of verbal prompts only to the use of either schedule to see if any schedule provided more reinforcement to students than verbal prompt alone. Finally, students and teachers completed measures of social validity. This study found that for two students, the iPad schedules resulted in an increase in independent activity-schedule following behavior as

well as a decrease in latency from the initial prompt instructing them to follow their schedules. All students showed a decrease in latency when using either type of schedule as compared to hearing verbal prompts only, which was the baseline condition. All teachers indicated they preferred the iPad schedules over the binder-based schedules, though only two students preferred them. Finally, the students generalized the schedule following behavior to new sequences and activities for both types of schedules.

Implications for practice in schools and other settings are that visual activity schedules, regardless of format, were more effective for independent transitioning than having a list of tasks presented orally, which was the baseline condition. Participants' teachers rated iPad schedules highly on social validity; teachers are more likely to use interventions with high social validity. Visual schedules on an iPad were effective for increased independence in transitioning as well as decreased latency, thus, they may help students with ASD function effectively in light of increased mainstreaming and inclusion practices in schools. Individual differences and preferences should be taken into account when considering the use of a visual activity schedule on an iPad or a binder-based visual activity schedule.

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CHAPTER I

INTRODUCTION

The Centers for Disease Control and Prevention (CDC) states the incidence of children diagnosed with autism spectrum disorder (ASD) is one in every 68 children (CDC, 2016). Children with ASD exhibit difficulties in communication, narrow scope of interests and activities, and resistance to environmental change (American Psychiatric Association, 2013; Heflin & Alaimo, 2007). ASD, prevalent in the elementary school student population, often causes students difficulty in transitioning from one task to another without continuous prompting from teachers or caregivers, who may be occupied with assisting other students. Further, with the common practice of inclusion, which has mandated students with ASD spend a certain amount of their day in their general education classroom, students are likely to be expected to make transitions with increasing independence as the students rise in grade level.

It is critical to address transitions between activities in the classroom (Center on the Social and Emotional Foundations for Early Learning, 2008). Transitions, by nature, take time, and students can spend a lot of time waiting. Transitions can be stressful and frustrating for students. Skills that aid in transitioning (i.e., the use of a visual schedule) may reduce transition times and increase task engagement. When students know what they are supposed to be doing, they engage in fewer problem behaviors. Students who successfully and independently transition between activities do so with few or no verbal prompts and do so quickly (e.g., under 60 seconds). Many professional educators

consider a student's ability to transition independently a key skill (Center on the Social and Emotional Foundations for Early Learning, 2008).

There are several ways poor communication and rigidity can cause students with ASD to experience challenges when completing tasks and transitioning from one task to another in the classroom. First, when changes in routine occur, students may cope with feelings of anxiety by exhibiting problematic behaviors (Steingard, Zimnitzky, DeMaso, Bauman, & Bucci, 1997). Another challenge can be dependence on prompts; if teachers consistently provide prompts during transition times, students may become dependent on prompts by adults even though adults may not always be readily available (Dettmer, Simpson, Myles, & Ganz, 2000). Further, with the trend towards keeping students with ASD in a general education classroom (Lindsay, 2007), students with ASD will likely face expectations from their teachers to be able to adapt and transition to novel tasks, activities, and environmental changes (Cihak, 2011).

Educators and caregivers have few options when selecting interventions to promote independence in transitioning for students with ASD. One intervention commonly used with students with ASD involves the use of a binder-based visual activity schedule paired with direct instruction, which requires considerable involvement from an adult caregiver. A visual activity schedule (also called a visual schedule) is a group of pictures and/or words which serve as visual prompts for an individual to engage in an activity or transition from one activity to another (McClannahan & Krantz, 1997). The mechanism of the visual activity schedule is prompting, which is anything added to instruction to help the student respond correctly. Visual activity schedules focus on replacing adult verbal prompts with the schedule serving as a visual prompt. Once a child

has received direct instruction on the use of the visual activity schedule, the goal is to minimize adult prompting, allowing the student to use the activity schedule alone as a visual prompt, or cue, to engage in tasks (McClannahan & Krantz, 2010). During this process, when the student fails to begin a step in the activity schedule, least-to-most prompting is used. In least-to-most prompting, adults typically provide the minimum level of prompting necessary to produce the desired response, with an eventual decrease in the number of prompts as well as intensity (verbal versus physical) resulting in independence (Milley & Machalicek, 2012). Once independent schedule use has been consistently demonstrated and prompts from a teacher or caregiver are minimal, schedule-following behavior should be strengthened by resequencing schedule activities in the current schedule and then adding novel tasks to check for skills generalization (McClannahan & Krantz, 2010). Although a traditional binder-based schedule may be helpful for some students with ASD, evidence suggests students with ASD demonstrate a preference for technology in learning and intervention delivery and have better responding in situations with fewer social demands (Stromer, Kimball, Kinney, & Taylor, 2006). This makes a binder-based schedule paired with adult prompting less than ideal.

Not only are visual activity schedules presented in a paper-based or binder format, but visual activity schedules can also be presented to the student on different types of electronic devices. The traditional presentation has the student manually changing the pages or moving pictures from one side of the Velcro chart to the other. These binders, posters, and boards are often stigmatizing and cumbersome to the student. The teacher or caregiver must manually change the papers within the schedule for each activity, and then create a separate binder, chart, or poster for each student. However, as the availability and

use of technology permeates modern classrooms, combining the technology that is already familiar to the student with the visual activity schedule presentation may increase independence in task transitioning for students as well as increased social validity of visual schedules for teachers, caregivers, and students. Once the teacher or caregiver creates visual activity schedule on an iPad, the teacher or caregiver can easily change the schedule by clicking once to take a photo of the new activity and deleting the old photo. The schedule is easily adaptable for different activities or different students, as opposed to the binder-based schedule, which requires the teacher or caregiver to take and print out a new photo or create a whole new binder for each student. Visual activity schedules on an iPad combine the technology already familiar and reinforcing for many students with ASD with the effectiveness of visual prompts. Unfortunately, there is limited research to offer evidence of the effectiveness of an iPad-based visual schedule to increase independence in activity transitions for students with ASD.

Significance of the Problem

Students with ASD often experience difficulties in transitioning between activities without considerable verbal prompting from adults and caregivers, who may not have the time to offer the amount of prompting necessary. Students on the spectrum also display problems engaging in tasks and activities as well as completing tasks and activities independently. Although students with ASD may have the ability to complete various tasks, difficulties were often experienced in transitioning between tasks when teachers or caregivers are not available to provide prompting (McClannahan & Krantz, 1997). Overreliance on prompts from teachers and caregivers may be problematic and have an adverse effect on the independent social, academic, and vocational functioning of the

student in the future (Milley & Machalicek, 2012). One of the problems with overreliance on teachers and caregivers is availability. Many teachers and caretakers for students with ASD are assigned to more than one student or have other responsibilities.

Transitions that are inefficient or disruptive to peers may have academic and social consequences for students with ASD. School districts now mainstream many students, a practice where students eligible for special education spend much of their time in a general education classroom with supports such as a paraprofessional. In the general education classroom, students with ASD are expected to adjust to new activities, tasks and settings while making an efficient transition between the various tasks (Cihak, 2011). Independence can be affected by the students' lack of ability in metacognitive tasks, which may include deficits in time management, ability to self-start, and organizational skills that are necessary for independence in the general education classroom (Maheady, Harper, & Mallette, 2001). When students use inefficient strategies during transitions, off-task and other challenging behaviors may ensue. It is well-known that off-task behaviors in school are disruptive for the student and peers, and often require adult attention and prompting (which may not be readily available) to redirect the student to the appropriate activity.

Although initial research has demonstrated the efficacy of using visual activity schedules delivered on hand-held devices for task completion and successful transitioning, one major flaw in the current research is the use of a rigorous study design. A rigorous study design is a scientific research design which includes elements such as operational definitions for all variables, measurable outcomes, social validity measures, reliability measures, and validity measures. Components such as these ensure that a study

can be precisely repeated to replicate the results. Knight, Sartini, and Spriggs (2015) performed a review of studies examining the effectiveness of visual activity schedules for students with ASD, finding only sixteen which contain the necessary elements to be considered scientifically sound. Of the sixteen considered acceptable, six did not include a formal social validity measure, eight did not include perspectives of adults, and 13 failed to include perspectives of students. Social validity data, absent in so many studies, could yield information just as valuable as the efficacy of the intervention. None included duration recording for length of time during transitions nor the immediacy or reinforcement for the visual schedules. Evidence is currently lacking which validates the effectiveness of visual activity schedules delivered on iPads for children with ASD for independent task transitioning.

Theoretical Basis for the Study

The theory behind the current study emanates from prior research on visual schedule interventions for children with ASD as well as the basic tenants of applied behavior analysis. Visual schedule use typically draws upon the principles of applied behavior analysis (Baer, Wolf, & Risley, 1968; Baer, Wolf, & Risley, 1987), which is a useful heuristic to developing classroom-based interventions (Milley, & Machalicek, 2012). Applied behavior analysis, used in the classroom, is also a component of effective teaching practices for all students, including students with disabilities (Milley & Machalicek, 2012). Applied behavior analysis includes the use of positive reinforcement after a desired (target) behavior which increases the probability of the desired behavior to occur in the future. Interventions including self-management skills, such as visual schedules, have taught students with and without disabilities to perform such tasks as

monitoring and evaluating their own performance and delivering reinforcers to self (Connell, Carta, & Baer, 1993; Stokes, Fowler, & Baer, 1978). Students have learned self-management skills during explicit instruction on the use of activity schedules. Students have also had the opportunity to practice and demonstrate learned skills while following the visual activity schedule. Additionally, research has shown self-management methods which are visual in nature have effectively taught children other skills as playing while unsupervised (Stahmer & Schreibman, 1992) or getting dressed and making a lunch (Pierce & Schreibman, 1994). Similarly, participants in the study were taught the skill of task engagement and transitioning. Visual activity schedules, when combined with positive reinforcement, likely increase self-management skills and independence in transitioning and activity engagement in children with ASD.

The teacher or caregiver can structure the visual activity schedule by incorporating the principles of applied behavior analysis. It is useful to structure the activity schedule in a manner where each activity increases in preference for the student. Ordering the activities by preference uses the Premack principle (Homme, Debaca, Devine, Steinhorst, & Rickert, 1963). The Premack principle posits if behavior B is less likely to occur than behavior A, then behavior A can be made more probable by making behavior B contingent on it. The First/Then technique orders activities by placing less preferred activities before more highly preferred activities. During the explicit instruction on schedule use as well as with verbal prompting, the teacher or caregiver may provide direction using the Premack Principle (e.g., "First write your name, then build a block tower"). For example, the first activity in the schedule should be a less preferred activity by the student. The next activity should be slightly more preferred, and so on, ending

with a highly preferred final activity, such as a snack. The principles of applied behavior analysis can be used as a lens to view the behaviors of students with ASD. Understanding the nature of principles such as positive and negative reinforcement and the Premack principle can inform one's conceptualization of problems of adult and caregiver independence as well as observed off-task behaviors during activity transitions.

Theoretical Terms

Autism Spectrum Disorder (ASD) - term used to describe a group of neurobiological Pervasive Developmental Disorders characterized by specific impairments in social interaction and communication and cause restricted and repetitive patterns of behavior as well as emotional detachment

Duration - the amount of time a behavior occurs

Error Correction - the process of providing the student with enough information to get it right on the next try

Generalization - the expansion of a child's performance of a task or skill beyond the initial conditions set for learning it; can occur across people, places, and materials used for teaching

Inclusion – practice of providing the least restrictive environment to students with disabilities by making their educational setting the same as their non-disabled peers where appropriate Students with disabilities spend a certain amount of their day in the general education classroom.

Prompt Fading - the process of eliminating the prompt and allowing the natural situation to take the place of having to provide the prompt. Can include decreasing the intensity of the prompt, graduated guidance, and using a time delay

Prompting - any additional help or assistance provided to ensure the child will get the correct response or produce the correct behavior

Prompt hierarchy - a list or series of prompts to be used; can move from most to least intrusive (most-to-least prompting; used when teaching a skill) or from least intrusive to most (least-to-most; used when assessing a level of confidence)

Task analysis - a list of steps or sub-skills for each skill to be taught; helps the teacher to be consistent with the teaching and helps identify where some of the difficult steps are for the child

Transition cue - a verbal or visual cue; lets the child know a new expectation is going to occur

Visual Activity Schedule – a series of pictures, photographs, or words used to communicate a series of activities or the steps of a specific activity; makes the student aware in advance the transitions about to take place

Review of Relevant Literature

A search of the literature found no studies comparing a visual activity schedule on an iPad with a binder-based schedule, where researchers collected data on activity transition duration for six to ten-year-old students with ASD. However, a limited number of similar studies were found and examined. In a dissertation study, Reinert (2016) investigated the effectiveness of using an iPad to teach visual activity schedule following (for play activities) to preschoolers with ASD. Reinert wisely included measures of social validity for the iPad based schedule as compared to a paper-based activity schedule by performing a choice assessment. Reinert used an iPad, with a specific app developed by Reinert herself, to compare the iPad schedule to a binder-based schedule. The iPad

schedule consisted of one activity picture per page (for the choice assessment portion only). The iPad displayed a graphic representation of bookshelves with activities on each one. The total number of activities completed independently during a session as well as the participants' independently completed activity schedule components were both measured. Reinert's study used a multiple baseline across participants design.

Reinert's findings indicated all three participants had a significant increase in both completed activities during the iPad-based activity schedule and increases in the percentage of correctly completed components. When preferences were measured, two children preferred the iPad-based schedule while one child preferred the paper-based schedule. Reinert did not ask the participants why they favored one type of schedule over the other, which may have yielded valuable information on the social validity of the schedules. Reinert's study showed that an iPad based visual activity schedule, using a specific app, may be effective for increasing independent in transitioning in leisure or play skills with preschoolers with ASD. Unfortunately, Reinert's study used a very young, narrow age range, a private school, and the findings are specific to an app developed by Reinert that may not be widely available. Reinert's study also did not measure times between the end of one activity and the beginning of the next (transition duration), which can be a critical indicator of success in activity transitioning behavior. A study was needed for the largest population of students receiving special education services, which spans kindergarten through the fifth grade in a public-school setting. Data are also needed to show that transition times decrease with the use of the intervention.

Finally, Reinert measured transitions between play or leisure skills for pre-school students. Older students face additional expectations and must complete less preferred

activities such as literacy and numeracy skills, for which transitions from a less preferred activity to a more difficult activity may present additional challenges. Researchers asked participants which type of schedule they preferred in this study but did not ask why they preferred one more than the other, a question which provides clarity on why one type of schedule may be more socially valid for a student.

Another dissertation (Gourwitz, 2014) measured on-task behavior and mean transition times when using an iPad-based schedule as compared to a paper-based schedule for students in kindergarten and first grade with ASD. Unfortunately, results from this study were inconclusive to determine which type of schedule produces a greater amount of on-task behavior as well as which type of schedule produces a decrease in mean transition time for students with ASD. Further, the researcher did not collect data regarding the social validity of each type of visual schedule from the student or teacher viewpoint. Outcomes showed one participant demonstrated an increase in on-task behavior using an iPad schedule, one student showed an increase in on-task behavior using a paper-based schedule, and one student showed no clear difference between schedules. When examining transition time, data were variable, with two students showing no clear difference in transition time between schedules and one student showing superior results when using the paper-based schedule. Results highlight the essential need for more research to determine which type of schedule produces a decrease in mean transition times, especially when considering the increasing focus on technology in the classroom as well as a mandate to use treatments with desirable outcomes.

Carlile, Reeve, Reeve, and DeBar (2013) performed a study examining the use of a visual activity schedule delivered on an iPod touch to teach schedule use to four

students with ASD between the ages of eight and twelve years. In Carlile et. al's study, the researchers did not measure number of prompts or duration of transitions. Data of this nature is needed and may help educators and scientist-practitioners better understand the relative effectiveness of an iPad-based schedule when compared to a binder-based schedule. The researcher in the present study gleaned some useful data from Carlile et. al's study. Carlile et al. used a multiple-probe-across-participants design. On-task behavior was measured as well as measures of independence (using prompt fading on a time delay procedure). Generalization to new settings and novel activities was also measured. The researcher included social validity measures for participants as well as community members. Findings revealed that following intervention, all participants learned to follow the visual activity schedule presented on the iPod independently. Results also show increase in on-task behavior as well as positive social validity reports for the iPod touch as compared to a paper-based schedule by the participants as well as the community. Therefore, a visual activity schedule delivered on a mobile device may be effective in increasing on-task behavior as well as independent schedule-following behavior and is preferred to a binder-based schedule by participants, peers, and community members.

Groundbreaking Research on Visual Activity Schedules

The methodology of modern visual schedule use developed from the groundbreaking work of McClannahan and Krantz (1997, 2010). McClannahan and Krantz based their findings from more than two decades of research on autism at the Princeton Child Development Institute (McClannahan & Krantz, 2010). While observing children with autism learning functional skills, data revealed they did not perform the

functional skills unless someone gave a verbal cue, modeled the target behavior, or gestured toward the materials. When no prompts were available, the children at the child development institute were observed to be engaging in stereotypy such as hand flapping, vocalizations, noncontextual laughter, repetitive behavior, or the children would wait for the cue. McClannahan and Krantz were interested in examining different teaching procedures and interventions to assist children with ASD in performing tasks and activities independently. McClannahan and Krantz developed and used visual activity schedules as an intervention for the lack of independence.

In addition to the research performed by McClannahan and Krantz (1997, 2010), there is other evidence suggesting the mechanisms of visual schedules are appropriate for students with ASD. Literature on interventions for children with ASD suggests students benefit from visual supports (Bryan & Gast, 2000; Dettmer, et al., 2000; Dooley, Wilczenski, & Torem, 2001; Heflin & Alaimo, 2007). Some of the advantages highlighted are the effectiveness of visual supports to allow students to organize and better understand their environments, anticipate certain scheduled activities, have an improved ability to understand the expectations of teachers and caregivers, and recognize and anticipate schedule and activity changes throughout their day (Cihak, 2011). Evidence shows students with ASD often respond to visual stimuli as their primary source of information (Quill, 1995, 1997). Therefore, using visual supports such as a visual activity schedule can assist students with auditory processing difficulties, a common symptom of ASD. Additionally, students with ASD have demonstrated a preference for photographs of people to people in vivo, even during direct interactions with people (Cihak, 2011). When researchers observed students with ASD performing

receptive language activities, they found students learned more quickly when a computer presented tasks instead of a teacher (Heimann, Nelson, Tjus, & Gillberg, 1995; Moore & Calvert, 2000).

The current researcher determined more research was needed to add to the robustness of the current research on visual schedule use for students with ASD, for example the landmark study on the use of photographic activity schedules by MacDuff, Krantz, and McClannahan (1993). Researchers used a graduated guidance procedure to teach four students with ASD, between the ages of ten and fourteen, schedule following to increase on-task and on-schedule behavior using a multiple baseline across participants design. Researchers also included generalization measures as well as data regarding prompting. The results suggest the use of photographic activity schedules resulted in sustained engagement, skills generalization to new sequences and photographs, independently transition between activities (when supervision or prompts from others were not available). One positive aspect of the MacDuff et al. study was the measurement of prompts. The current study examining visual schedule use extends MacDuff et al.'s findings further by measuring transition durations, to ensure students are making smooth, independent transitions without wasting time unnecessarily. The immediacy of reinforcement, or how quickly the student receives reinforcement from the caregiver, as a baseline, to the immediacy of reinforcement of each of the types of visual schedules, is helpful data that may allow professionals to determine whether to use an iPad based visual activity schedule or a binder-based visual schedule to increase independence in activity transitioning.

Problem Statement

Students with ASD often face difficulties in independent task transitioning as well as social and academic performance in school due to rigidity in thinking and sensitivity to change in routine. Although elementary age children with ASD have the ability to learn interventions and may learn best from visual and auditory methods (National Institute of Mental Health, 2017), they may become over-reliant on caregivers for prompts when following their daily routine and during activity transitions. Depending on caregivers for prompts is problematic because adults may not always be available, especially as the student grows older and there are increased expectations to complete a routine independently. Although students with ASD often carry a binder or poster with a visual schedule on it, modern teaching practices utilize technology to a greater extent than in the past. Yet, teachers and caregivers do not always deliver proven interventions, such as visual activity schedules, in a technological modality. Visual activity schedules presented in a book format have been found socially stigmatizing and cumbersome for students with ASD (Carlile et al., 2013). Delivery of a visual activity schedule on a technological device such as an iPad touch may provide a more portable, discreet and socially acceptable format (Carlile et al., 2013). The purpose of the current study was to address the gap in the research literature regarding evidence for the effectiveness of visual activity schedules in increasing independent transitioning when delivered on an iPad for children with ASD between the ages of six and ten years. Such an evidence base will undoubtedly aid key stakeholders in their decisions to spend their limited educational resources on technology with proven effectiveness. More importantly, students can begin

incorporating visual schedules on a mobile device into their daily lives to assist in developing into independently functioning individuals.

Research Questions and Hypotheses

Q1 Do visual activity schedules delivered on an iPad increase independence in transitions more than visual activity schedules delivered in a binder-based format for students with ASD between the ages of six and ten years old?

H1 Visual activity schedules delivered on an iPad increase independence (as measured by one or less verbal prompts from an adult) in transitions when compared to visual activity schedules delivered in a binder-based format.

Q2 Do visual activity schedules delivered on an iPad decrease the duration of transition times to a greater extent than a binder-based schedule for students with ASD between the ages of six and ten years old?

H2 Visual activity schedules delivered on an iPad significantly decrease the duration of transitions when compared to a binder-based format.

Q3 Do visual schedules presented on an iPad or in a binder format provide more immediate reinforcement than relying on a caregiver's verbal prompts alone?

H3 Visual schedules on an iPad or in a binder format offer more immediate reinforcement when compared to relying on a caregiver's verbal prompts alone.

Q4 Does the participant's teacher or caregiver prefer visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format?

H4 The participant's teacher prefers visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format.

Q5 Do students prefer visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format?

H5 The student prefers visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format.

Q6 Can the participant generalize independent task transitioning to novel sequences and tasks when using an iPad-based schedule?

H6 The participant can generalize independent task transitioning to novel sequences and tasks when using an iPad-based schedule.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The purpose of the current study was to determine the comparative effects of an electronic visual activity schedule delivered on an iPad to a traditional binder based visual activity schedule for young children with Autism Spectrum Disorder (ASD) to increase independence activity completion and transition. In this review of the literature, ASD, the mechanisms of visual schedules, independent transitions, schedule use with various populations and settings, social validity, electronic visual schedule use, treatment integrity, and future research are discussed.

Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a developmental disability and neuro abnormality which affects nearly every aspect of a child's cognitive, social, emotional, and physical development. Individuals with ASD exhibit deficits in areas such as communication, social interaction, and interests and activities (American Psychiatric Association, 2013). There are some consistent key features in children with ASD, though individual differences in presentation and severity do occur. Features include perpetual difficulties in social communication and interaction across multiple contexts (APA, 2013). Characteristics also include stereotypy in motor movements, lining up or fidgeting with objects, echolalia, and idiosyncratic phrases (APA, 2013). Children with ASD may exhibit insistence on sameness, routines, and rigidity in thinking. They also may hyper-

focus on objects and interest, showing intense fixation on them. Children with ASD may seek out or dislike excessive sensory input from their environment.

Generally, symptoms present early in the child's life, though symptoms may fully manifest as the child develops. To meet criteria for ASD, symptoms must cause significant impairment in one area of functioning such as social or occupational (APA, 2013). Symptoms can occur with or without intellectual or language impairment, with or without a known medical component, and across three categorical levels of severity (APA, 2013). Children diagnosed with ASD have been determined to meet the threshold for clinically significant impairment in functioning due to ASD symptoms (Centers for Disease Control, 2016).

The school environment may confront children with ASD with challenges resulting in an inability to effectively function in that environment without extensive support from teachers and caregivers. Children with ASD often exhibit off-task behaviors and require an excessive number of prompts before displaying on-task behavior at home and school. Deficits in language, challenges with social interaction, and limited interests or repetitive behaviors may impede skill acquisition and overall learning. Demands for same activities and schedules, a lack of flexibility when following routines, demonstration of verbal or nonverbal behaviors (which could include marked anguish over minuscule changes), problems with transitioning from one activity to the next, rigidity, and inflexibility in thought likely impact many of students with ASD in the school environment.

These children's resistance to change in their environment negatively affects them because of inability to predict future activities and events, and because it can manifest in

difficulties coping with minor changes in daily routines (Heflin & Alaimo, 2007). Students who display rigidity in thought impacts a teacher's ability to establish new routines and procedures in the classroom as these changes can trigger anxiety in students with ASD, which may lead to undesirable behaviors (Steingard, et al., 1997). Although children with ASD can typically complete many different tasks, they often display difficulty in making transitions between tasks without prompting (McClannahan & Krantz, 1997), leading to the concern children with ASD may be overly dependent on prompts from parents, teachers, and other adults (Dettmer, et al., 2000). Some negative consequences of caregiver dependence are the child may experience a marked decrease in functioning in social, academic, and vocational areas when the caregiver or teacher is not immediately available, and henceforth, teaching independent behavior can become problematic (Milley & Machalicek, 2012). It may be challenging for teachers to keep these students engaged in instructional activities (MacDuff, Krantz, & McClannahan, 1993). These students may also lack the skills necessary to self-start when tasks are presented or fail to show a previously learned skill with spontaneity (MacDuff et al., 1993).

ASD is pervasive in the student population. The Centers for Disease Control and Prevention (2016) states the incidence of children diagnosed with ASD is one in every 68 children. The CDC estimated the number of children with ASD by methodically by combining the reported prevalence rates of ASD from 11 ASD and Autism and Developmental Disabilities Monitoring (ADDM) Network sites for children eight years of age. The CDC reports sizable increases in the estimated cases of ASD in the United States since the 1990s. Two studies from the 1980s, during which time the DSM-III

diagnostic criteria were used to diagnose ASD, estimated there were approximately 3.3 out of 1,000 children between 3-18 years of age with ASD and 3.6 out of 1,000 children between 8-12 years with ASD. In the 1990s, the ADDM Network used educational and administrative surveys as well as public health records to determine the prevalence was 3.4 per 1,000 children aged 3-10 years. Since then, from 2007-2010 the ADDM Network has released estimates per 1,000 children which range from 6.7 in 2000, to 6.6 in 2002, to 9.0 in 2006, to 11.3 in 2008, to 14.7 in 2010 (CDC, 2016). In 2013, with the publication of the DSM-5, there was a substantial change in the diagnostic criteria for ASD, which may make comparing the number of children with the diagnosis of ASD before and after 2013 difficult. First, four previously separate disorders (autistic disorder, Asperger's disorder, childhood disintegrative disorder, and pervasive developmental disorder – not otherwise specified, were all re-labeled as ASD (APA, 2013). New criteria for ASD required symptoms in two domains: social communication/interaction and restricted interests/repetitive behaviors. Finally, a new diagnosis of Social Communication Disorder was added for individuals who did not meet the criteria in the domain of restricted interests/repetitive behaviors.

Regardless, because of the increasing number of children being identified as having ASD, and due to practices often required such as inclusion, a practice which places students with identified disabilities into general education classrooms with appropriate support services, an increasing number of students with ASD are receiving their education in a general education classroom (Lindsay, 2007). It is in the general education classroom where children with ASD likely face expectations to adjust to and smoothly transition to new tasks, activities, and settings (Cihak, 2011). Students with

ASD encounter more than just challenges with academic tasks; they often exhibit deficits in metacognitive tasks, which may include time management, organizational skills, and similar skills which may impact independent participation in the general education classroom (Maheady, et al., 2001). These factors provide the basis for the development and application of instructional and other strategies to enhance students' independence from adults (Milley & Machalicek, 2012). Using evidence-based intervention can assist students with ASD in becoming more independent and overcoming academic challenges.

Visual Schedules

A visual activity schedule is a group of pictures or words acting as stimuli to prompt an individual to engage in a sequence of activities (McClannahan & Krantz, 2010). The purpose of creating and teaching a visual activity schedule is to allow children with ASD to engage in tasks and activities without direct prompting and guidance by parents, teachers, or additional staff (McClannahan & Krantz, 2010). Visual activity schedules are visual supports depicting a sequence of events the child is expected to follow and have been shown to aid in independent transitioning from one activity to the next with minimal prompts. Traditional visual schedules include visual prompts typically consisting of pictures or words. More modern visual schedules use tablets, iPod touches, phones, or other forms of technology (Burckley, Tincani, & Guld Fisher, 2015; Cihak, 2011; Kaye, 2000; Reinert, 2016; Spriggs, Knight & Sherrow, 2015).

Banda and Grimmett (2008) proposed future research comparing the effectiveness of different types of pictures (for example, line drawings vs. photographs) as well as sizes. Banda and Grimmett noted no comparative research on modes of presentation conducted as of 2008. Presently, there continues to be limited research comparing

effectiveness and desirability related to modes of presentation. Banda and Grimmett's (2008) comments tie into the current study, which compared two different delivery systems and topographies of photographs with children with ASD.

Definition and Mechanisms of Visual Schedules

Knight et al. (2015) examined 16 studies on the use of visual schedules for children with ASD. Intervention effects, when measuring 26 dependent variables, were overall positive. Nineteen of the 26 dependent variables in the studies on visual schedules suggest high levels of efficacy. Visual schedules shown effectiveness for four variables, and questionable efficacy for three variables. The impressive outcome was all studies concluded visual activity schedules were effective for the dependent variables measured.

Banda and Grimmett (2008) reviewed thirteen studies, pointing to several rationales on why visual activity schedules may be effective for students with ASD. They found that task analyses in visual schedules may provide predictability in expected behaviors. Researchers also proposed students with ASD, and other developmental disabilities may display desired behaviors and responses when expected behaviors are displayed step-by-step and in a successive manner. The researcher discussed principles of positive and negative reinforcement in this study, and how each photograph in the visual schedule may serve as a discriminative stimulus (SD) for beginning the next behavior or step in the sequence. A discriminative stimulus is a stimulus in the presence of which a specific response will be reinforced (Malott & Shane, 2015). Similarly, researchers pointed out, photos within the schedules may provide visual prompts to students, leading to performance of the target behavior. Quill (1995) similarly found visual supports, which function as visual prompts, evoke greater responding in individuals with ASD.

Evidence-Based Intervention

There are many interventions used in the school environment for children with autism, to attempt to overcome challenges with caregiver dependence, activity completion, and task transitions. Regrettably, there are only a limited number of interventions which meet the criteria for being evidence-based (Knight et al., 2015). Evidence-based practice relies on data obtained through experimental research which points to the efficacy of a treatment. According to Horner et al. (2005), an intervention is evidence-based when five studies meet acceptable criteria in quality across three different researchers and studies, in three different geographical locations, and with 20 participants. The criteria for acceptable quality are the intervention are operationally defined, the context and outcomes are clearly defined, the intervention is implemented with fidelity, the intervention is functionally related to change in targeted outcomes, and experimental control is demonstrated across an adequate range of studies. Kratochwill et al. (2013) described how the What Works Clearinghouse, a collection of interventions and their data describing efficacy, has adopted these standards as well. Additionally, in scholarly peer-reviewed scientific research, there are five levels of evidence for treatments for single-case (also known as single-subject) design. Level I, the highest level of evidence, requires an alternating treatment design with clear-cut results as well as generalizability measures across three or more subjects (Logan, Hickman, Harris, & Heriza, 2007). Data-based decision making, utilizing an evidence base, may lead to measurable positive outcomes.

For evidence-based interventions which have shown effectiveness in students with disabilities, there are common elements such as direct instruction, behavior

modification, and an element of visual support (Spencer, Evmenova, Boon, & Hayes-Harris, 2014). A review examining eleven intervention studies on teaching mathematics to children with ASD showed effectiveness; researchers reported six of these studies implemented visual representations, such as manipulatives, pictures, graphs, and number lines (Barnett & Cleary, 2015). Five studies used cognitive strategy instruction targeting math skills, which involves a series of steps or sequenced procedures using rules and processes. These both meet criteria for and are considered evidence-based interventions for improving math skills in individuals with developmental disabilities (Barnett & Cleary, 2015). Spencer et al. (2014), in reviewing twenty-eight studies for teaching core subjects to students with ASD, found effective interventions included visual supports, technology-based instruction, concrete representation, direct instruction, and behavioral interventions. Peer-mediated interventions, where typically developing peers are trained to initiate interactions with their peers with ASD, using pivotal response techniques, scripted phrases, and social strategies, have been shown effective in increasing positive social interactions (Watkins et al., 2015). These strategies are consistent with the common practice of using behavioral techniques and prompting with children with ASD. In a review of evidence-based interventions for students with ASD, Milley & Machalicek (2012) found activity schedules, tactile prompting, and peer support interventions increase student engagement and decrease adult dependence. Based on the literature reviewing interventions for students with ASD, it appears some form of direct instruction, behavior techniques, and visual supports are effective in teaching skill acquisition and task completion.

When considering interventions for students with ASD that meet criteria for being evidence-based, three separate literature reviews, each comprised of thirteen to sixteen studies, support the notion of visual activity schedules as evidence-based practice for students with ASD (Banda & Grimmett, 2008; Knight et al., 2015; Koyama and Wang, 2011). In one review, Knight et al., (2015) concluded fifteen studies utilizing visual activity schedules meet criteria for being evidence-based, thus, visual activity schedules are an evidence-based practice for increasing an array of behaviors. In another review, Banda & Grimmett (2008) reviewed thirteen studies utilizing activity schedules with individuals with ASD and all were found effective for increasing on-task behavior and transition skills. Behaviors for which reviews concluded visual activity schedules meet the criteria for evidence-based practice are on-task, on-schedule, and independent transitions, to improve latency from prompt to task completion or completed responses, and decreased prompts needed for successful transitions.

Visual Schedules Across Populations and Settings

Visual activity schedules have been studied and found effective with diverse populations and ages, as they accommodate a wide range of individual differences (Koyama & Wang, 2011) including populations with varying degrees of ASD and intellectual ability (Banda & Grimmett, 2008). Koyama and Wang (2011) found not only were schedules effective for students with ASD, but visual schedules were effective for promoting independence in students with intellectual impairment and Down syndrome (Koyama & Wang, 2011). Cihak (2011) similarly concluded effectiveness, with different types of visual schedules may be effective for differently abled children.

Visual schedules are effective interventions for children, youth, and adults with ASD for several reasons. Teachers and caregivers may use activity schedules to reduce behaviors during transitions as well as off-task behaviors (Pierce & Schreibman, 1994; Bryan & Gast, 2000; Krantz, MacDuff, & McClannahan, 1993; Massey & Wheeler, 2000). Individuals with ASD typically respond to visual stimuli as their main source of information in their environments (Quill, 1995, 1997) and often demonstrate a preference for photographs of people over directly interacting with people (Cihak, 2011). Students with ASD have also shown improvements in independence (Watanabe & Sturmey, 2003), play behaviors (Dauphin, Kinney, Stromer, & Koegel, 2004; Morrison, Sainato, Benchaaban, & Endo, 2002), and transition time (Dettmer et al., 2000; Dooley et al., 2001; Massey & Wheeler, 2000). For students with ASD, researchers reviewed studies on visual schedules consistently found effectiveness for both traditional and electronically presented visual activity schedules across 16 studies including 56 children and adolescents (Banda & Grimmett, 2008). Participants were between the ages of three and 21 years, and attended preschool, elementary school, middle school, or high school. Koyama and Wang (2011) reviewed the literature and concluded effectiveness for students from pre-school age to adult in homes, schools, and group home settings.

Prior research has specifically focused on using visual activity schedules for children between the ages of three and seven, or early elementary. Dauphin et al., (2004) found a three-year-old with ASD could follow routines using a visual schedule consisting only of photos after being taught how to perform the tasks using video modeling. A 6-year-old student was able to follow a computer schedule, eventually generalizing for the activities of independent play, dramatic play, and play bids, after receiving recorded

instruction (Stromer et al., 2006). A 7-year-old with ASD was able to learn spelling skills, and a 4-year-old with ASD was similarly able to learn and demonstrate counting after using video modeling instruction to break down the activity into smaller tasks (Stromer et al., 2006). Developmentally, rate of skill acquisition changes over the life span and is more pronounced in young children, making direct instruction on the use of visual schedules particularly salient for young children. Students in early childhood with ASD who have previously learned to use a visual activity schedule can follow a tablet-based schedule (Reinert, 2016). Kaye (2000) posited that even though technology is a fundamental part of most people's lives, an integral part of our society, adults with disabilities are less likely to use it. Thus, it is critical to teach children with disabilities to use technological supports when they are young, such as when they are in the early elementary grades.

Researchers have found visual activity schedules effective for older elementary age, teenagers, and adults as well. Carlile et al. (2013) studied four participants between eight and 12 years old with ASD in a public school setting to measure the participants' ability to perform a sequence of leisure activities. Using an iPod touch and manual prompting procedures, the photographic activity schedule was effective; all participants completed a high percentage of the activity schedule tasks and increased their percentage of intervals with on-task behavior. Carlile et al. (2013) also concluded partial generalization of skills had occurred, as students participating in le leisure activities successfully generalized to a novel location. Older students have also demonstrated a wide scope of skill acquisition as a result of learning to use the iPad, which culminated in meeting the goal for increased independence for participants (Spriggs et al., 2015).

Students were able to transition independently both within and between tasks and demonstrated high rates of generalization to the visual activity schedules and new tasks after removing the technological support (video modeling). Additionally, four boys between the ages of nine and 14 years have demonstrated on-task and on-schedule behavior when using an activity schedule including photographs (MacDuff, et al., 1993). Burckley, et al. (2015) found an iPad-based picture and video activity schedule was effective in increasing community shopping skills of an 18-year-old adult with ASD and intellectual disability. While it is promising visual activity schedules can be used across the early life-span of individuals with ASD, there is a gap in the research related to children in the six to ten years of age range, examining visual activity schedules on electronic devices, especially in comparison to more traditional modes of schedule presentation.

Not only have researchers found visual activity schedules effective with various populations, but researchers have found effectiveness in a variety of settings such as pre-schools, middle schools, elementary schools, group homes, and in participants' own homes (Koyama & Wang, 2011). Banda and Grimmett (2008) reviewed thirteen published studies on visual schedules and similarly concluded their effectiveness in settings such as school, home, work, and play. Banda and Grimmett reported the general education setting and the self-contained setting were the most often settings used in research, with other settings consisting of a university-based preschool, a residential group home, a worksite, and a combination of home and community settings. Koyama and Wang's (2011) literature review of activity schedule research concluded schools were the most frequent site for activity schedule use, as visual activity schedules may be

helpful in increasing student engagement and independence in the school setting. When parents implemented visual activity schedules in the home using a notebook format for children with ASD, results were increased task engagement and social initiations as well as a decrease in undesirable behaviors (Stromer et al., 2006). Visual activity schedules were also used in the home of a 6-year-old boy with ASD, including video modeling and prompting the child to perform 4 activities, which he performed correctly and generalized (Stromer et al., 2006). A researcher used technology-based activity schedules with three young boys with ASD in a university-based preschool, who effectively learned play skills (Reinert, 2016). According to Kaye (2000), technology such as an iPad may provide students with a socially acceptable, age-appropriate tool to provide additional support in school, home, and community settings.

Activity schedules have shown effectiveness in middle school and high school settings. Researchers found effectiveness in the middle school setting for participants between 11-15 years of age with an IQ in the 40-55 range (Alberto, Cihak, & Gama, 2005). When comparing static-picture schedules to video-based schedules for three students with ASD in two middle schools, activity schedules were found to aid the students in transitioning between activities in a classroom (Cihak, 2011). In a high school setting, Spriggs et al., (2015) used talking picture schedules to increase independence in students with ASD. Researchers used a multiple probe across participants design, focusing on transition between activities (Spriggs et al., 2015). An iPad-based visual schedule, when used with an 18-year-old with ASD, was found to increase her independence in following a shopping list, which generalized to three different community locations (Burckley, et al., 2015). Skills were found to be maintained once

the intervention was withdrawn, and the skills also generalized to two additional items which were unlearned (Burckley, et al., 2015). Regardless of the setting, it is paramount to teach children with ASD to use visual activity schedules with high social validity valid for them because individual supports may not be as accessible in postsecondary settings, which could potentially cause negative educational and vocational outcomes for students with ASD who failed to gain independence from frequent verbal prompts given by adults (Milley & Machalicek, 2012).

Types of Behaviors Addressed Using Visual Schedules

Visual activity schedules are an effective means of bolstering independence and teaching appropriate task engagement (Koyama & Wang, 2011). Visual activity schedules, when used to teach skills, have been used to assist in the direct instruction of important skills including play, academic, and self-help, while concurrently decreasing dependence on prompts and undesirable behaviors (MacDuff et al., 1993; McClannahan & Krantz, 2010). Prior to much of the research on visual activity schedules, other research found self-management procedures which were visual in nature, were effective for promoting many skills such as teaching children to play when unsupervised (Stahmer & Schreibman, 1992), helping children get dressed without assistance, and make their lunch (Pierce & Schreibman, 1994). Visual activity schedules, when used as a classroom-based intervention, emanates from knowledge in the field of special education on effective instructional practices for students who have disabilities as well as students who do not (Milley & Machalicek, 2012).

Qualities of Visual Schedules That Improve Their Effectiveness

Visual activity schedules can teach children, whether identified with disabilities or more typically developing, to ascertain whether or not their performance is correct, and to enlist teacher praise when it is (Connell et al., 1993; Stokes et al., 1978). These skills can be taught explicitly during instruction on visual activity schedules. Part of the mechanism behind visual schedules is to provide the student with increased time to process changes in their daily activities, which strengthens the opportunity for the child to have greater participation in existing routines and transitions (Cihak, 2011). These schedules may provide a sense of predictability in the child's day by organizing and sequencing parts of a task or events of a day; thereby students can anticipate changes in their routine (Banda & Grimmett, 2008).

As previously explained, visual schedules work by using photographs, line drawings, or written words to represent activities (Koyama & Wang, 2011). Written words are known to have the weakest association to their respective activity, and object symbols (e.g., soapy hands referring to the activity of eating a snack) have the strongest, most salient association (Koyama & Wang, 2011). Thus, individuals need to have the cognitive ability to understand the relationship between a two-dimensional symbol and the activity to which it refers (Koyama & Wang, 2011). Additionally, the theory and underpinnings of applied behavior analysis drive techniques such as the Premack Principle (requiring a low probability behavior to be performed before allowing a high probability behavior), prompting, explicit instruction, and positive reinforcement (Baer, Wolf, & Risley, 1968; Baer, Wolf, & Risley, 1987). Evidence supporting picture activity schedules considers them to be an adaptable antecedent-based intervention which can be

tailored to meet many challenging behaviors. Interventions such as self-management strategies teach children to choose reinforcers, monitor and evaluate their performance, and deliver reinforcers to themselves. Visual schedules may prompt steps within a task, replacing verbal prompts (Banda & Grimmett, 2008).

Visual activity schedules can range in topography, i.e., written checklists, symbols attached with Velcro, books with large pictures, on a computer with presentation software, presented on a personal digital assistant, or on a device such as an iPod touch (Mechling, 2007). Banda and Grimmett (2008) found for visual schedules to be effective in children with ASD, the activity or skill needs to be represented by a picture, displayed in some format, and taught using a variety of prompts selected based on the needs of the student. Knight et al. (2015), evaluated the modes of presentation of 16 studies, in a review. Ten studies used a procedure showing only one picture a time (such as a binder, book, or photo album), while seven studies used a procedure wherein, they presented all the pictures at once (e.g., horizontal schedules or pictorial schedules attached to cardstock with Velcro). Only five studies used technology; four used a video format, and only one used a picture schedule on an iPod touch. One noteworthy study showed independence in leisure activities can be accomplished through the adoption of activity schedules (Massey & Wheeler, 2000). Researchers used a sequence of photographic or written prompts which match specific tasks in a chain of activities.

A teacher or caregiver needs to train the student on the use of the visual activity schedule. Procedures researchers have previously used to train students on the use of visual schedules vary. Of the sixteen studies reviewed by Knight et al. (2015), 14 studies used explicit instruction to teach schedule use, while two studies used no instruction or

prompting. Nine studies used prompting procedures, which are well established for teaching skill acquisition to individuals with ASD. Additionally, four of the 12 studies which used direct instruction also included reinforcement as a component of the training. Once students are trained and have practiced using visual schedules appropriately, they should be able to transfer the schedule-following behavior to novel tasks and settings, also known as generalization.

Generalization of Schedule Use

The ability to generalize the use of visual schedules, or to follow several activities in the schedule with less than one verbal prompt from the caregiver, to novel tasks and environments is a true measure of whether a visual activity schedule intervention will continue to be successful for the child. One impediment to independence for students with ASD is though they learn and demonstrate new skills, they often lack the ability to generalize the new skill once supports such as verbal prompting are faded (Hume, Loftin, & Lantz, 2009). Koyama and Wang (2011) found, in the small number of studies which included measures of maintenance and generalization, participants exhibited engagement and on-task behavior in new settings, at different times of the day, and with new activities. Similarly, Banda and Grimmett (2008) observed that less than half of the 13 studies in their literature review on visual activity schedule use included generalization measures, an important consideration for students with ASD. Additionally, Massey and Wheeler (2000) concluded the child with ASD could learn the skills needed to independently follow activity schedules and generalize activity following skills with minimal training, suggesting the use of visual cues in an activity schedule is effective with children with ASD in a typical classroom in a school setting.

Teachers should use systematic prompting procedures to aid the students in learning the skills necessary to independently use their visual activity schedules (Tarbox, Wallace, Penrod, & Tarbox, 2007). Learning schedule-following behavior can be accomplished through direct instruction by the teacher or caregiver. The overall goal of using visual activity schedules is to increase independence in completing a chain of tasks with minimal prompting, enabling students with ASD to use the visual activity schedule itself as a cue to complete tasks and transition appropriately (McClannahan & Krantz, 2010). The current study focuses on using a least-to-most verbal prompting procedure, allowing students to demonstrate independence in transitions between activities, facilitated by the visual activity schedule intervention. In a review of interventions fostering independence for students with ASD, Milley, and Machalicek (2012) found a procedure wherein students who do not complete a step on their visual schedule were provided with the least number of prompts needed to perform the activity, resulting in students completing the entire activity schedule. The goal is greater independence which students achieve when they require minimal verbal prompts from adults when transitioning between tasks or activities, and can rely on visual cues, which may be more readily available in their environment.

Stephenson (2015) expressed the need for research which includes measures of schedule use generalization once mastered. In a review of schedule following behaviors published in 2011, Koyama and Wang concluded only 26% of the studies in their review examined maintenance, while only 39% included measures of generalization of the schedule-following behavior. In Banda and Grimmett's 2008 review, less than half of the studies included measures for assessing generalization. Studies including generalization

measures reported overall positive outcomes with respect to new settings, activities, and people, but researchers suggest more research is needed. The findings from the literature reviews highlighted the need for a study with strong research design which would incorporate measures of maintenance and generalization. One way to determine if generalization has occurred is to observe instances in which the number of verbal prompts needed to complete all activities within the schedule is less than one, suggesting independent activity schedule completion.

Independent Transitions

Visual schedules are effective interventions for reducing an ASD child's dependence on adult prompting. One cannot overstate the importance of the ability of students with ASD to appropriately transition from one task to another with minimal prompting. When researchers surveyed 700 teachers and administrators, they indicated that students with disabilities are in close proximity to a paraprofessional for over 86% of their day (Giangreco & Broer, 2005). There is a real concern that students with ASD receive so many prompts from parents, teachers, and other adults that they may become overly dependent on them (Dettmer, et al., 2000). When students with ASD are dependent on teachers and caregivers, the student may experience decreased functioning in social and academic areas when the caregiver or teacher is not immediately available, which has the potential to make learning independence more difficult (Milley & Machalicek, 2012). Lacking the ability to self-start tasks, spontaneously demonstrate a previously learned skill, or remain engaged in instructional activities are negative consequences of dependence on adults (MacDuff et al., 1993). One method of decreasing adult prompting, according to researchers, is to provide students with ASD a visual

activity schedule which sequentially depicts activities or steps within an activity with visual representations (Banda & Grimmett, 2008; Banda, Grimmett, & Hart, 2009; McClannahan & Krantz, 2010). Visual activity schedules are evidence-based for promoting independence and self-management skills for a wide range of individuals with ASD and intellectual disabilities (Koyama & Wang, 2011). Though visual activity schedules of many different types are evidence-based, they may differ on measures of social validity.

Social Validity

The social validity of an intervention refers to the social desirability and usefulness of changes in behavior (Kennedy, 1992). Social validity demonstrates the social value of a targeted behavior and the intervention used to change it (Kennedy, 1992). Measures of social validity are critical because when social validity is high, stakeholders perceive the target behavior as important, and the behavior-change intervention is more likely to be implemented with integrity. When assessing the social validity of an intervention, the examiner should direct attention to the perception of the desirability of an intervention for the teacher or caregiver as well as the student. While binder-based, low-tech visual schedules on their own are effective, they continue to require a great deal of adult attention. Further, technology such as an iPad (or other device) may be more desirable to students than low-tech schedule methods, such as binders, because it allows the student a more socially acceptable and age appropriate means or added support in the school, home, or community settings. Parette, Wojcik, Hourcade, and Peterson-Karlan (2005) stress the role of perception, for students with and without disabilities, of assistive technology.

Teachers often evaluate the narrow offering of evidence-based practices for students with ASD to find interventions with the highest likelihood to produce desired outcomes. Schwartz and Baer (1991) found when adults such as teachers and caregivers view the intervention as effective, important, and simple to implement, the result is a successful outcome. Koyama and Wang (2011) found that only 30% of the studies reviewed in the literature included data on the social validity of the schedules, though the data available was positive. Social validity data is essential in determining if the teachers and caregivers trust the schedule is promoting independence for the student. Some notable outcomes included acceptability of the intervention, positive changes in behavior, and decreased need for supervision.

There have been some stated social validity concerns for teachers and caregivers with traditional binder based schedules, such as they can be difficult and time intensive to prepare (Carlile et al., 2013). High-tech schedules may be overall simpler and faster for the teacher to prepare, as electronic schedules eliminate the need to print, photocopy, or laminate. Parents of young children with ASD also have a lack of time and resources to build a visual schedule (Reinert, 2016). However, once teachers or caregivers create an electronic schedule or template, it can often be used repeatedly for new material or new students (Stromer et al., 2006).

Though the evidence available is somewhat limited in terms of comparing visual schedules which utilize technology with visual schedules which are low-tech in nature, schedules on an iPad have other advantages in terms of desirability for students (Stephenson, 2015). Many visual activity schedules are presented in book format, which can be cumbersome for a student as well as socially stigmatizing for a child with ASD

(Carlile et al., 2013). Presenting a visual activity schedule on a device such as an iPad touch or similar device may also provide a more portable, discreet and socially acceptable format (Carlile et al., 2013). Although some researchers have attempted to use presentation software on a computer to create visual activity schedule, they recognized challenges due to the lack of portability for students and recommended using a less expensive, more portable "low-tech medium" in future studies. The portability of a visual schedule on an iPad is beneficial, especially for students with ASD who may spend part of their day in a self-contained classroom and other parts of the day in their general education classroom. Incorporating video modeling into electronic visual schedules has been shown effective, but researchers have pointed out the additional noise and visual stimulation from the video footage could cause adverse outcomes for students with ASD. In terms of the student's natural environment, in the self-contained classroom as well as the general education classroom, students with ASD as well as typically developing students are likely to use popular technological devices such as the iPad. When compared to a binder-based schedule, two of three participants with ASD preferred an iPad-based schedule (Reinert, 2016).

Students often find time on the computer reinforcing; thus, integrating an electronic component to visual activity schedules could be beneficial (Stromer et al., 2006; Stromer & Oross, 2000). Visual activity schedules in an electronic format can not only be intrinsically reinforcing for a child with ASD but less challenging in terms of reduced eye contact and similar social demands when compared to live teaching (Stromer et al., 2006). Stromer et al., (2006) concluded, by observation, children with ASD routinely preferred instruction presented by a computer when compared to instruction

presented by a live teacher. Stephenson (2015) suggested future research should focus on using the technology of the iPad with visual schedules. Stephenson recommended research using strategies to teach students to use a schedule which requires scrolling and completion of a sequence of activities.

Outcomes and perceived effectiveness of interventions influence teachers and caregivers' perceptions of effectiveness of interventions. In Cihak's 2011 study, two students with ASD showed the best outcomes when using video modeling, while one student with ASD had better outcomes with a static schedule, and one student with ASD performed similarly with both. More consistency in outcomes is needed to justify using resources to create visual activity schedules for students with ASD. Although further research may help clarify these findings, if two interventions work equally or nearly as well as one another, the teacher may choose the one with more socially validity based on current resources within the classroom (Cihak, 2011).

Researchers can increase the social validity of visual activity schedules by incorporating tasks into the schedule having high social validity for the student. Koyama and Wang (2011) reviewed the literature surrounding visual schedule use and found seven studies where students successfully learned to create and follow their own schedules. Self-scheduling as part of visual activity schedule use may be critical for promoting autonomy and self-sufficiency by selecting tasks with social validity for the individual. Watanabe and Sturmey (2003) found when students participated in the creation of the activity schedule, their engagement in the task activities increased. The findings related to self-scheduling and task engagement justify the choice-making element used in the current study.

When considering the social validity of targeted activities and skills, it is essential to include choice-making while simultaneously examining the skills to be included in a visual activity schedule. For example, McClanahan and Krantz (1999), in their book on visual activity schedule use for children with ASD, suggest inclusion of academic activity, an activity involving social skills, a leisure activity, and a rewarding life skill type activity such as a snack. However, Knight et al. (2015), in their review of sixteen studies with rigorous design procedures, found in all but one study, visual schedules were used for one type of activity: play and leisure activities, academic activities, daily living tasks, work skills, and homework activities. The current study combined four activities from similar categories, thus demonstrating schedule following behavior over a wide array of activities, which more closely resembles a typical schedule. Knight et al. (2015) also noted only two of the studies reviewed utilized a visual schedule on a personal digital device. Knight et al.'s findings underscore the need for more rigorous studies to support utilizing portable electronic technology in the room since limited research appears propitious.

There are gaps in the literature in terms of evaluating the social validity of interventions which include a visual activity schedule component. In the Knight et al. review (2015), 10 of the 16 studies reviewed incorporated a formal social validity measure. The authors noted six studies without a measure of social validity as a limitation. Eight of the studies reviewed included perspectives of adults, while three included perspectives of students. All sixteen described positive responses to the intervention. Interestingly, one study reported that teachers favored picture schedules to video ones, even though they perceived the video schedules as more effective. All

teachers reported the feasibility of visual activity schedules in the classroom. Future research, as with the current study, should gather social validity data from students and teachers to allow for more robust conclusions on the acceptability of a binder-based schedule as well as an iPad format in increasing independence in transitions for students with ASD.

Researchers can influence the social validity of an intervention by the saliency of it, such as whether an intervention draws attention to a student. According to McClannahan and Krantz (1997), a traditional schedule is conspicuous, as a paraprofessional (teaching aid) or parent carries the schedule in a binder throughout the day, prompting the student with words or non-verbal cues to look at the schedule. Children with ASD may be hesitant to carry traditional visual schedules with them throughout their day due to a perceived stigmatizing effect (Carlile et al., 2013). However, modern approaches to teaching integrate technology and learning in a typical school day (for example, an iPad). It may be socially valid for a young student to carry and use a visual schedule on an iPad throughout one's day, just as teenagers and adults may carry and use cell phones for similar purposes. Carlile et al. (2013) believed presenting an activity schedule on a mobile device was discreet, portable, and may provide a more socially acceptable format if prompts and an adult's presence were eventually removed. In Burckley, et al.'s study (2015), using an iPad picture schedule to teach shopping skills to a young adult with ASD, they viewed social validity surveys indicating goals, procedures, and methods of the intervention positively. If students begin learning and practicing at a young age to use a technology-based visual schedule, it can continue to assist them throughout growth and development.

Students in today's modern educational settings receive instruction with and have greater opportunities involving technology than in the past. Electronic and other technological devices may be more accessible to students than teachers and caregivers, providing prompting in the absence of these adults (Alberto, Fredrick, Hughes, McIntosh, & Cihak, 2007; Davies, Stock, & Wehmeyer, 2002; Mechling & Savidge, 2011; Riffel, et al., 2005). Technology is intrinsically reinforcing for students with ASD, who have demonstrated a preference for technology, where social demands such as eye contact are minimal (Stromer et al., 2006). With the goal of reduced need for prompting, technology-based interventions, such as visual schedules on devices, can have the benefit of decreased dependence on adults (Spriggs et al., 2015). Although teachers and caregivers deliver some interventions technologically, this is not always true for visual activity schedules. By increasing the amount of research on the effectiveness and social desirability of electronic visual activity schedules, more professionals may become aware of the potential of technology-based visual activity schedule interventions.

Using technology to visually cue students has not gone unchallenged. One research team, Stromer et al., 2006), voiced uneasiness about students simply transferring dependence from an adult to a machine. However, Wolery, Ault, and Doyle (1992) explained that reliance upon adaptations and supports is preferred to reliance upon caregivers because assistive technology is more immediately available in the child's environment. Wolery et al.'s point was valid, as students with ASD following a visual activity schedule may demonstrate a greater degree of functional independence due to reduced social demands involved in interacting with the technology-based schedule. In another study, Mechling and Savidge (2011) evaluated the use of a personal digital

assistant (PDA) on the completion of new tasks and independent transitions of three students with ASD. Task completion rates and transition within activities increased (Spriggs et al., 2015). Wolery et al. (1992) also rightly posited it is more beneficial for individuals to rely on adaptations and supports rather than to rely on prompting from caregivers.

When a student develops the ability to transition between multiple tasks independently, the student often increases on-task behavior and task engagement, which are favorable in the classroom environment. When students are on-task, they are practicing and developing valuable skills. In a review of visual schedule literature, Koyama and Wang (2011) found activity schedules increase engagement and on-task behaviors as well as independence in task initiation and transition. Koyama and Wang's review also emphasized the decrease in prompt dependency and increase in independent schedule following in several studies.

Prior research has studied whether visual schedules presented in electronic formats such as an iPad promote independent task transitioning in students. Spriggs et al. (2015) investigated the use of visual activity schedules with embedded video models on an iPad to ascertain if high school students with ASD were able to transition between and within new activities. Researchers used a multiple probe across participants design. Prior to the start of the study, all four participants relied upon adults to provide directions or prompting to complete certain tasks or transition between tasks. However, after the intervention, which consisted of a video model of task completion and transition behaviors, the students generalized the behaviors, completing transitions completely independently (Spriggs et al., 2015). Although the positive outcome could be due in part

to the video modeling component, visual analysis of the findings by the researchers indicates a combination of video activity schedules and video modeling was effective in teaching two participants to enter data into an Excel spreadsheet, solve two equations, and to set a table. All the participants were able to transition between skills independently and generalized the use of the picture (non-video) visual activity schedule alone as well as to new tasks. Two other studies indicated that children with ASD may learn more quickly when tasks are presented in an electronic format rather than by a teacher (Heimann et al., 1995; Moore & Calvert, 2000).

McClannahan and Krantz (2010) found that activity schedules only promote independent transitioning between tasks if the tasks are already in the child's behavioral repertoire. Koyama and Wang (2011), in a review article, confirmed activity schedules were effectively used in schools for transitions between activities which were already in the participants' repertoires. Activities in Koyama and Wang's review ranged from play and leisure choices to academic tasks, to more vocationally focused tasks.

For future research, it may be helpful to examine the effects of using the same or differing schedules with regards to outcomes and student preferences (Cihak, 2011). In the current study, visual schedules were individually tailored to each student after consulting with their teachers. Along with student preference, the student's functional use of visual activity schedules presented on an iPod touch versus one in a binder format may yield data on the effectiveness (Carlile et al., 2013). Researchers collectively agree that more research should be conducted on visual activity schedule use for students with ASD, especially in the area of electronic visual schedules.

Future research on technology-based schedules, such as schedules using an iPhone or iPad, may be advantageous due to the rapid technological advancements in our environment as well as social acceptability of portable electronic devices (Koyama & Wang, 2011). Individuals with intellectual disability successfully used a schedule on a portable, handheld device, resulting in increased task accuracy and independence (Davies et al., 2002). Researchers have stressed strengthening future research by including social validity measures focusing on teachers and caregivers (Koyama & Wang, 2011). Including social validity measures in future research is critical because the teachers and caregivers implementing visual schedules must recognize them as effective and helpful. There is currently a gap in the literature in measuring social validity, as less than half of the thirteen studies in one review examined social validity, which may support increased use of visual activity schedules for individuals with ASD (Banda & Grimmett, 2008).

Variations Within Single Case Design

Knight et al. (2015) reviewed the types of research study designs used in the literature on visual activity schedules. Of the sixteen studies reviewed, four used a multiple baseline across participants, five studies used withdrawal designs, two used alternating treatments design, and two used an adapted alternating treatment design. Three studies examined employed a design using multiple probes across participants, or across tasks and participants. The current researcher found no studies that included a return to baseline phase to reduce the carryover effects of the intervention.

Researchers conducting future research on visual activity schedules should rigorously design future studies. A concern noted by Knight et al. (2015) was out of the thirty original scholarly studies in their analysis, about half did not meet research

acceptability standards. Researchers reported a lack of study replication sufficient to confirm external validity. Other problems researchers found with studies were absence of experimental effect, failing to report IOA, and lack of social validity measures. Additionally, most studies lacked descriptive data and did not report the severity of the student's ASD, though the ones which did reported less severity. It was notable that few participants were female, even taking into account the smaller prevalence of females with ASD compared to males. Researchers believe future studies should include more female participants and participants who are more severely affected. Further, researchers suggest there should be more research on using visual activity schedules for academic and daily living tasks, as most research focuses on play and leisure activities. Finally, Knight et al. (2015) recommend more studies using different types of schedules, modes of presentation, and effects of systematic learning of visual schedules on different participants. Specifically, researchers make two noteworthy suggestions: a comparison of using a video schedule in comparison to a more traditional schedule format, and more research including the use of personal portable devices. There is a gap in the literature for a study on visual activity schedule use for students with ASD that includes an alternating treatment design component, with a return to baseline phase, with data on social validity from the students' as well as the teachers' and caregivers' points of view, treatment integrity, and generalization probes.

Treatment Integrity

When conducting a single case study using an intervention, it is paramount to implement the intervention with fidelity, also known as treatment integrity. Treatment integrity, often measured as a dependent variable, is critical to the acceptability of a

research study implementing an intervention. Including data on treatment integrity contributes to rigor in the design of a study. Ensuring the implementation of treatments with fidelity, which can be achieved by utilizing a task list or having treatment integrity assessed by interobserver agreement, gives greater value to the observed outcomes. In the review previously cited, Knight et al. (2015) found all sixteen studies measured interrater reliability, which ranged from 98 to 100%. Thirteen studies also measured procedural reliability, which ranged from 98 to 100%.

Conclusion

The current body of research supports the use of visual schedules for students with ASD for increasing independence in task completion and task transitioning as well as an increase in task engagement. However, the literature falls short where technology-based visual schedules are concerned. While some research of this nature includes electronic elements such as visual activity schedules on iPods, computers, and other mobile devices, there is a hole in the research related to schedules delivered on iPads, which are common throughout many schools today. This study also focused on participants with ASD who have varying degrees of functioning, filling the gap in the literature related to lower and moderate functioning students using visual activity schedules. Further, the present researcher found no studies which measured the actual duration of transition times when comparing the two types of visual schedules. When independence increases, the duration of the transition times should decrease, indicating the student is on task. No studies found have examined the immediacy of reinforcement for the different types of schedules, and this study aimed to fill that hole. When visual schedules are readily available, and students are trained to use them, the student does not

have to wait on a teacher or caregiver to prompt the student to begin the next task, freeing the staff of unnecessary intervention and empowering the student to self-manage transitions. Most studies have used a traditional schedule presentation, such as a binder-based schedule or chart, but with the increasing use of technology in schools, combined with the reinforcing effects of electronic devices, electronic devices may offer increased social validity for visual schedules delivered on an iPad. The current researcher found no studies which examined social validity from the perspective of the teacher, caregiver, and student. Because of the importance of social validity to the everyday use of the intervention, additional research is needed to answer how socially desirable each type of schedule is perceived.

Considering the reality of the common practice of inclusion, which mandates students with ASD spend a certain amount of their day in their general education classroom, students are expected to make transitions with increasing independence as they rise in grade level. Electronic visual activity schedules offer opportunities for increased independence, as students respond to visual prompts on a socially desirable device, cueing them to complete a series of tasks. Using visual schedules in the place of prompting from a caregiver may have certain advantages for the student with ASD such as immediacy of reinforcement and preference for interaction with technology over person-to-person interaction. For many students with ASD, technology is inherently reinforcing. The present study explored the efficacy of a visual schedule presented on an iPad in relation to a visual schedule presented in a binder-based format.

Based on a review of scholarly literature, it was critical to examine if visual activity schedules delivered on an iPad increase independence in transitions more than

visual activity schedules delivered in a binder-based format for students with ASD between the ages of six and ten years old. More research demonstrating efficacy of visual schedules delivered electronically may promote buy-in and justify utilizing resources for iPad-based schedules. It is also important to ask if visual activity schedules delivered on an iPad decrease the duration of transition times to a greater extent than a binder-based schedule for students with ASD between the ages of six and ten years old. Transitions are critical because when done smoothly, students remain on task. However, if a student with ASD experiences challenges with transition, it may take many verbal or physical prompts from adults to help the student start the next task. These adults may not always be readily available. When considering visual schedules presented in different formats, it is essential to study whether or not visual schedules presented on an iPad or in a binder format provide more immediate reinforcement than relying on a caregiver's verbal prompts alone. If visual schedules presented on an iPad provide the student more immediate reinforcement, the schedules have the ability to shape the child's behavior, increasing independence in task transitioning. Finally, the social validity of the two types of visual schedules needed to be examined to ensure a good fit with the student's environment. Interventions with a higher level of social desirability are more likely to be used with fidelity.

CHAPTER III

METHODOLOGY

Research Questions

This study asked six key research questions with the purpose of informing interventions using low-tech and high-tech visual schedules for students between six and ten years old with ASD in a public elementary school setting. First, the researcher wanted to determine if visual activity schedules delivered on an iPad increased independence in transitions without verbal prompts to a greater extent than visual activity schedules delivered in a binder-based format. An additional goal was to determine if a visual activity schedule delivered on an iPad decreased the duration of transition times to a greater extent than a binder-based schedule for this population. The current study examined the question, "Do visual schedules presented on an iPad or those presented in a binder format provide more immediate reinforcement than relying on a caregiver's verbal prompts alone?" For social validity, the researcher examined if the student's teacher or caregiver preferred visual activity schedules delivered on an iPad or visual schedules delivered in a binder-based format. The researcher collected additional social validity data by asking the student to choose the type of visual schedule they would like to use first during their generalization check. Finally, the researcher performed generalization checks to novel tasks and sequences after the conclusion of the final intervention phase.

The study tested the following hypotheses:

Research Questions and Hypotheses

Q1	Do visual activity schedules delivered on an iPad increase independence in transitions more than visual activity schedules delivered in a binder-based format for students with ASD between the ages of six and ten years old?
H1	Visual activity schedules delivered on an iPad increase independence (as measured by one or less verbal prompts from an adult) in transitions when compared to visual activity schedules delivered in a binder-based format.
Q2	Do visual activity schedules delivered on an iPad decrease the duration of transition times to a greater extent than a binder-based schedule for students with ASD between the ages of six and ten years old?
H2	Visual activity schedules delivered on an iPad significantly decrease the duration of transitions when compared to a binder-based format.
Q3	Do visual schedules presented on an iPad or in a binder format provide more immediate reinforcement than relying on a caregiver's verbal prompts alone?
H3	Visual schedules on an iPad or in a binder format offer more immediate reinforcement when compared to relying on a caregiver's verbal prompts alone.
Q4	Does the participant's teacher or caregiver prefer visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format?
H4	The participant's teacher prefers visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format.
Q5	Do students prefer visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format?
H5	The student prefers visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format.
Q6	Can the participant generalize independent task transitioning to novel sequences and tasks when using an iPad-based schedule?

H6 The participant can generalize independent task transitioning to novel sequences and tasks when using an iPad-based schedule.

Researcher

The researcher is a fifth-year doctoral-level graduate student in School Psychology at the University of Northern Colorado. She also completed the Board Certified Behavior Analyst course sequence and required field experience. She is currently on internship at Florida State University, where she provides evaluation and diagnosis of ASD as well as direct behavioral health services to children and teenagers with ASD. She has also had experience with this population as a Licensed Professional Counselor and elementary school teacher.

Research Design

The research design for this study was a multiple treatment reversal design, including a return to baseline in between two of the intervention phases. The study was an A-B-C-A-B-C design. The researcher required four stable data points (or a clear pattern of instability) before implementation of the next phase of the intervention. The features of this type of design compare two or more experimental effects to the baseline condition and includes a return to baseline phase within the intervention phases to reduce carryover effects (Cooper, Heron, & Heward, 2007).

Each student participated in an initial baseline phase, which consisted of four to five data points (eight to ten intervention periods across five days, two per day, each consisting of 20 minutes). The researcher began collecting baseline data individually on each participant beginning with the first intervention session on the first day of the study. All participants began the study on the same day. After at least four points of data for

baseline were collected for each participant, the participant moved into phase A of treatment, which consisted of the binder based visual activity schedule. The researcher collected a minimum of four data points for each of the remaining treatment phases. New phases of treatment or return to baseline condition only occurred when the researcher observed a stable data pattern, or the data continued to be stable in its unpredictability. In phase “C”, the participants used the iPad version of the visual activity schedule. Again, the researcher collected data for each phase for at least four data points. Each treatment phase was repeated two times, with a return to baseline in the middle; therefore, the design of the study was A-B-C-A-B-C with two additional data points collected the week after the last intervention period to measure generalization of the schedule following behavior. In the event a student was absent or otherwise unavailable during an intervention period, the intervention session did not need to be "made up" because the student's data consisted of four stable data points already, showing the student was ready to move to the next phase. During the study, if there is no stability in a phase after five data points, due to time restraints and the number of school days left, the researcher considered this instability as a pattern and continued on to the next treatment phase.

The procedures analyzed for treatment integrity during the intervention phases (“B” and “C” phases) were identical except for the prompting procedures. During generalization checks, the procedure reverted back to the identical baseline procedures, with only verbal prompts and an activity list provided to the child. The researcher collected data for treatment integrity on over 33% of the baseline sessions, 40% of “B” and “C” intervention sessions, and 50% of the generalization checks. Acceptable treatment integrity was determined by dividing the steps outlined above and multiplying

by 100%. Acceptable treatment integrity is typically at or above 80% (Morgan & Morgan, 2008).

Threats to internal and external validity were anticipated and controlled for. First, students were observed during the initial baseline to determine that they do not always engage in a task and do not easily transition from one task to another. The participants were pre-screened for this criterion through teacher interviews. Sufficient phases in this study prove covariation between the visual activity schedule format and the number of prompts received to increase schedule following behavior and transitioning from one activity to another, which are measures of independence in schedule following. Any potential alternate explanations for behavior (recent illness, familial stress) were to be noted if known, though I was not aware of any of these. Teachers were instructed to maintain stability and predictability in the child's environment, though any environmental concerns that could potentially affect the outcome were noted and discussed. Maturation was controlled for by completing data collection in less than six weeks, though the researcher consulted with the students' teachers to anticipate any psychological changes during this time. No attrition occurred during this study.

For instrumentation effects, the researcher established criteria that eligible students must have the skills required to operate an iPad by teacher interview. There were no concerns related to internal validity such as history, as the student's parent, guardian, or teacher was required to confirm that the student has demonstrated schedule-following behavior before. The parent, guardian or teacher also had to confirm that the student had previously demonstrated basic skills related to tablet technology, such as the ability to touch and navigate to various pages on a tablet. The internal validity threat of testing was

controlled by a return to baseline in the study, to reduce carryover effects. Regression threats were minimal because, though students have extreme scores, the researcher required stability in the data before moving to the next phase, thus ensuring observation of their true abilities. Selection procedures ensured that students were a diverse range of individuals, ages, and genders. Attrition was attempted to be controlled for by recruiting two more participants than needed, in case of experimental mortality, but only three student's parents signed consent to participate.

External validity is also necessary for a scholarly study, and any threats to this should be anticipated and controlled for. Confirmation bias is one threat to external validity. This was controlled for by using clearly defined, objective procedures to collect and analyze data. Data recording measures clearly indicated if the behavior was performed or not, using operational definitions for the behaviors the researcher was measuring. Teachers and paraprofessionals were trained and educated on confirmation bias prior to the beginning of the study. Using a multiple treatment reversal approach demonstrated that the dependent variable is a function of the independent variable, as there were two phases which demonstrated consistent results in the level of the behavior by recording the number of prompts received. Teachers were instructed to abstain from altering the physical environment of the child in any manner during the intervention Finally, the intervention was delivered by the teacher or paraprofessional first, to minimize the Hawthorne effect (though the researcher may be present in an unobtrusive fashion). As the students acclimated to the researcher's presence, approximately three days after intervention sessions began, the researcher or teacher delivered the intervention in the same manner and in the same private space in the school. The study may not be

generalizable to every student with autism, because of the nature of ASD, which presents very differently across individuals. However, one or more treatments were found effective, and it may be reasonable to conclude that they would be effective for other children with similar characteristics, overall functioning, and behaviors. The study reduced external validity because the school is the child's natural environment during the day, and the study was scheduled to begin after the child has had enough time to acclimate to the school environment, towards the end of the school year. Finally, lighting, noise, time of day, location, and having a person familiar to the child deliver the intervention were additional ways external validity was controlled for. There were no other concerns related to external validity.

Instrumentation

The researcher used two instruments in this study. The main instrument was an Apple iPad Air 2, borrowed from the special education department at the school, with the permission of the special education director. The iPad Air 2 had a screen size of 9.7 inches and weighed 0.96 pounds. The resolution of the iPad Air 2 used the iOS 8.1 operating system, had a resolution of 1536 x 2048, and had an Apple A8X CPU. The iPad also had an internal working camera which was used to take pictures of common classroom objects and to create a photographic visual schedule. The visual activity schedule was inside the "gallery" app, which displays photos on most iPads. The iPad photo gallery contained an album for each participant. The other instrument used in the study was a visual activity schedule delivered in a 10"x12" binder format. Each instrument displayed a visual schedule which included four tasks, represented by four pictures on four separate pages. The pictures consisted of items familiar to the child and

which the child would associate with the task (as reported by the child's teacher or paraprofessional). The pictures had a plain white background, clearly showed the item as the focal point, and contained an embedded script (e.g., "snack" on the picture of crackers). The pages were inside plastic sheet protectors so that they could later be replaced with ease when checking for skills generalization. The only observable difference between the schedules was the electronic format, and the procedure for accessing the schedule.

Measures

The researcher used several measures and instruments in this study. The dependent variables in this study provided outcome data related to the use of visual schedules in an iPad format as well as a binder-based format when compared to baseline, which was no visual schedule. During baseline and intervention phases, verbal prompts given by an adult (teacher or researcher) were measured for each activity within the activity schedule and summed to get an overall measure of the child's required prompts during that intervention period. Transition times were measured by the researcher or researcher designee, using a stopwatch, in minutes and seconds beginning with the tact, “Do your work” for each intervention period. Minutes and seconds between the tact and the desired behavior were measured, suggesting the degree of reinforcement the student received from the binder-based or iPad based visual schedule. The researcher measured time during baseline periods as well as intervention periods, with the goal of examining if adult reinforcement or schedule reinforcement was more immediate.

The researcher measured how many of the four activities the student completed with one or less verbal prompts, through direct observation, as a secondary dependent

variable. This quantitative information provided insight into how the student was progressing, e.g., the student was able to complete only the first transition independently with the binder-based schedule but completed three transitions independently with the iPad schedule.

For social validity, the measure used was the teacher's total score on the Adapted Version of the Intervention Rating Profile-15 (IRP-15), which is used to measure educational interventions (IRP-15; Harris et al., 2012; Martens, Witt, Elliott, & Darveaux,1985). This measure includes a pre-intervention and post-intervention questionnaire and is a shortened version of one used in prior research (Witt, Martens, & Elliott, 1984). This measure contained 15 statements related to the acceptability of the intervention. The raters provided responses based on the degree of agreement or disagreement via a six-point Likert-type scale. Higher scores indicated greater acceptability of the intervention. The scale indicates a moderate degree of acceptability if a total score is at least 52.5 (Carter, 2009). Because the IRP-15 was only intended to offer an overall measure of "general acceptability", the primary factor in a factor analysis yielded loading ratings from .82 to .95, and internal consistency reliability using Cronbach's alpha was .98 (Martens et al., 1985). The teachers completed two pre and two post-IRP-15 scales for each student; two before the collection of baseline data and the other two after generalization checks, due to the two different activity schedule formats used in this intervention.

To assess the social validity of the intervention for students, a simple interview was conducted post-intervention and the responses of the participants and recorded. The researcher asked the students once, "Which type of schedule would you like to use?

Show me." The researcher presented the participants with the two schedules. After the student selected the schedule they preferred, the researcher initiated the process used throughout the study, prompting the student to complete the visual schedule, checking for generalization. During the next intervention session, the student was asked to use the visual schedule they had not chosen as preferred, and the researcher collected generalization data for that schedule type.

Treatment integrity, an important element which contributes to the overall quality of a study, was measured and analyzed systematically. The researcher collected and documented data on treatment integrity. During the baseline phases ("A" phases), the following elements were examined: (a) list of activities is within reach of the child, (b) iPad is not present, (c) binder schedule is not present (d) materials for activities are within 10 feet of the child, (e) teacher, paraprofessional, or researcher gives the instruction, "Do your work," (f) only verbal prompts are provided for each activity and transition.

Two task analyses for explicit instruction of schedule use pertaining to the binder as well as the iPad were provided to each child's teacher (see Appendix E). The researcher educated the teacher on how to explicitly instruct the child on visual schedule use by following this task analysis. The researcher retained a copy of this task analysis during the intervention phases. The teacher and researcher (who initiates the explicit instruction process) completed steps of the task analysis pertaining to the current intervention phase, checking for implementation fidelity for the explicit teaching component.

Reliability for all phases of the intervention was measured using an inter-rater reliability method on 20% of all baseline and intervention sessions. The goal for

agreement between the researcher and teacher (or secondary observer) was at least 80%. Had this amount of agreement not been present, the researcher planned to examine which steps were not being implemented with fidelity and re-train teacher in the intervention technique of explicit instruction if applicable. Then the researcher would have re-taught the student on how to use a binder based or an electronic visual schedule (depending on which phase of the intervention they were beginning). A data recording sheet was used by the researcher (and teacher during inter-rater agreement checks) to record data related to schedule use including the number of prompts received for each of the four activities on the schedule and number of completed activities with only verbal prompts received out of four possible activities (see Appendix C).

As is customary for single-case research design, visual analysis was used to determine the effectiveness of each intervention by measuring the number of verbal prompts the student received during each intervention phase and looking at rate, level, and variability of the verbal prompts. Additionally, the researcher analyzed the effectiveness of each schedule in increasing independence in transition (which includes decreased verbal prompting), by counting the number of verbal prompts given during each transition. To determine effect size, the researcher used a procedure known as TauU (Parker et al., 2011a; Parker et al., 2011b) TauU is nonparametric and distribution-free, allowing statistical control of a baseline trend, if necessary. Consistent with visual analysis, it works by combining non-overlap in the data with the trend in the data.

Measurement

The study examined three dependent variables and two measures of social validity. The number of verbal prompts given before the child transitioned from one

activity to the next was recorded on a data recording sheet. The number of prompts provided information used to determine the amount of independence in independent transitioning between tasks. Successful independent schedule following behavior was said to occur when the individual received one prompt or fewer during the intervention. Another dependent variable measured was the number of activities completed in the activity schedule with only verbal prompts. The number ranged from one to four activities completed. Again, successful schedule completion required the participant to complete all four tasks in the order they are presented on the schedule with no more than one prompt. Finally, duration, in minutes and seconds, was recorded by the researcher or teacher, using a stopwatch, from the initial tact to the beginning of the activity. Data regarding the time between the initial tact to begin the schedule-following behavior (or between the verbal prompt and the behavior) provided information on the degree of reinforcement each schedule (or the adult, for baseline) provided the student as well as data explicitly connected to the duration of transitions for each treatment condition.

Social validity of the schedules for teachers or paraprofessionals as well as the child was also measured. Teachers completed the IRP-15 for each schedule delivery system before and after the intervention. A score of 52 or above indicated social validity for that instrument. The researcher asked the students if they would like to use the binder based schedule or the iPad schedule during the generalization check, after all intervention sessions. Their preferences indicated the social validity of the schedule delivery system for that individual child. Skills generalization was also measured using identical data recording sheets but using different pictures and tasks. Generalization occurred if the

child completes four novel tasks (or familiar tasks in a novel sequence) with no more than one prompt from an adult.

Participants

All participation in the current study was strictly voluntary. First, the University of Northern Colorado's Institutional Review Board (IRB) approved the study (Appendix A), then the Weld County District 6 IRB approved the study and agreed to participate (Appendix B). Recruitment procedures included using email to contact the special education director, who referred the researcher to the school psychologist at a specific school in his district. The researcher contacted the school after each IRB granted permission for research. The school psychologist asked two special education teachers to identify students who would be a good fit and meet participant criteria pre-determined in the study. The school district initially identified five students.

Next, after confidential consultation between the teachers and school psychologist, the teachers attempted to call the parent and discuss the study, asking if the parent or guardian would be interested in meeting with the researcher to learn more. In consultation and planning, the researcher referred each potential participant by a pseudonym to protect confidentiality until the parent agreed for their child to be in the study and gave permission for the school officials to release the student's name to the researcher. Although the teachers offered to arrange for a meeting between the parent or guardian and the researcher at the school, none of the parents agreed to participate in the meeting. Therefore, the researcher sent home literature explaining the study, including risks and benefits, to each participant's guardian. Participants' parent/guardian was required to sign and acknowledge informed consent, indicating their willingness to have

their child participate as well as an understanding of the expected risks and benefits of the study. The parent was asked to sign an informed consent document and receive a copy of the same to keep for their records. The informed consent outlined and described the study, explaining the rights of the parent or guardian to withdraw consent at any time. It also provided the credentials of the researcher and provided expectations for the participant and the parent or guardian. The researcher informed parents and guardians that the participants would be compensated for their time with a gift of an inexpensive electronic tablet and cover, with a list price of no more than $50, within two weeks of the conclusion of the study. A questionnaire was also sent to parents/guardians to collect demographic information regarding each participant.

Recruitment ended when three of the five participants agreed to participate in the study and returned the required forms. Although recruiting all five students would have been ideal due to the ability to collect more data, resulting in more outcomes, in single-case design, Level I, the highest level of evidence, only requires generalizability measures across three or more subjects (Logan, et al., 2007). After receiving consent to release educational records, the school psychologist verified an educational diagnosis of autism spectrum disorder for each participant. An educational diagnosis of ASD typically follows the clinical guidelines for ASD, but the child typically must exhibit these symptoms at school, and their symptoms must cause them difficulty in accessing education. Clinical guidelines for ASD include diagnostic criteria in two categories: persistent deficits in social communication and social interaction (category A), and restricted, repetitive patterns of behavior ,interests, or activities (category B; American Psychiatric Association, 2013). After verifying the education diagnosis for each

participant, the study was explained to each child in a developmental and age-appropriate manner by their teacher. The student was asked to sign an assent to participate in this study, and their teacher explained the informed consent to the student in a developmentally appropriate way.

Inclusion criteria for recruiting participants included having an educational diagnosis of ASD, being between the ages of six and ten years, and attending a public elementary school in Colorado. Participants regularly spent most of their time in a self-contained special education classroom. Participants included one male and two females; females were recruited more strongly due to gaps in the research literature concerning interventions for females with ASD. Students were qualified by confirming with their teachers their knowledge and experience in the use of visual activity schedules of any type.

Sample selection methods included recruiting participants through pre-identification by one of their teachers or the school psychologist. Participants were pre-screened for the above-mentioned criteria by the researcher. The researcher gave preference to students who were female and also to students experiencing difficulty at school with on-task behavior and between-task transitions as reported by their teacher. Five students were initially identified and recruited but there were three final participants. Sample selection procedures occurred at an elementary school in Colorado, the Greeley-Evans School District 6. The researcher made exclusionary criteria on the basis of the appropriateness of the intervention to the child's level of functioning (those with severe symptoms of ASD). Individuals with no prior history of schedule learning and schedule were excluded from consideration.

Three children with ASD participated in this study. For single-case design to be considered valid, three participants are needed. In peer-reviewed scientific research, there are five levels of evidence for treatments for single-case design. The highest level of evidence, Level I, requires an alternating treatment design with clear-cut results as well as generalizability measures across three or more subjects (Logan et al., 2007). Beginning participant recruitment with study with five participants would have allowed for the study to continue even if two students desired to or needed to drop out. However, there was only one month of school left when the study was approved by the university and school district IRB. The researcher decided that if attrition occurred, the study would continue with the number of participants remaining, and the researcher would not replace the student or students.

Participants' parents or caregivers and teacher provided some basic demographic information about their child and family. Emily is a 10-year-old Caucasian female living in northern Colorado. She receives her education in a self-contained special education classroom to support her diagnosis of ASD. Her parents are married, in their 30's, hold bachelor's degrees, and are employed full-time. Emily also lives with two sisters. Emily's teacher stated Emily has very limited experience using an iPad at home or school, and is not familiar with the device. Anecdotally, the researcher observed Emily's verbal expressive communication skills to be very low, though her receptive communication skills appeared to be low to below-average. Emily exhibited excessive motor movement before and after the intervention sessions, though she appeared focused during the intervention sessions.

Vincent is an eight-year-old Hispanic/Latino male living in northern Colorado. He receives his education in a self-contained special education classroom to support his diagnosis of ASD. Vincent lives with his mother, grandmother, and brother. His mother has a high school diploma, is in her 30's, reported being divorced, and works full-time. Vincent's teacher stated Vincent has had no exposure to an iPad at home or school, and is not familiar with the device. The researcher observed Vincent's verbal expressive and receptive communication skills to be below average to approaching average (higher than the other two participants). Vincent did not exhibit tics, excessive motor movement, or repetitive body movements during the researcher's observation.

Tabatha is a six-year-old Caucasian female living in northern Colorado. She receives her education in a self-contained special education classroom to support her diagnosis of ASD. Tabatha's parents are married, in their 30's, and have some college education. Tabatha lives with her parents and a sibling. Her parents are employed full-time. Tabatha's teacher stated Tabatha has had no experience using an iPad, and is not familiar with the device. Anecdotally, the researcher observed Tabatha's verbal expressive communication skills to be very low, though her receptive communication skills appeared to be low to below-average. Tabatha exhibited rocking movements and excessive motor movement before and after the intervention sessions, though she appeared mostly focused during the intervention sessions.

Procedures

Following approval by the Institutional Review Board (IRB) at the University of Colorado as well as the IRB of the school district, five students were pre-selected to participate in the intervention. The students' teachers, the school psychologist, or special

education director referred the students. The researcher screened the students for the need for the intervention, educational diagnosis of ASD, and severity of symptoms based on teacher interview. After the teacher called the parents, she sent a letter explaining the study in further detail as well as a letter of consent. The student's teacher explained the study and requested assent for participation from the student. After receiving informed consent as well as assent, the intervention process began.

During the baseline and intervention phases, the researcher or researcher designee served as the data collector. Each intervention for the twenty-four-plus data points (and two additional generalization data points), took approximately 20 minutes. The study occurred in the child's natural environment. The intervention area was a small, private room near the child's main classroom, or at times, a quiet corner in the library, which was also familiar to the child. The decision regarding location as well as the time of day for the intervention was made after consultation with the child's teacher and based on availability. The decision about the time of day was made based on the availability of the participant, making sure that the participant did not miss core instruction time or special services. This research study occurred on each day of each week, as long as the student is present and school was in session, with the generalization measures taking place the week following the final phase of the intervention. If the student was absent, the researcher analyzed the data, but each time this happened, the student had enough stable data points to move to the next phase in the study.

The first step before collecting baseline data involved training the teacher or paraprofessional to deliver the intervention with fidelity. The steps in the intervention delivery were simplified using a task analysis sheet (see Appendix E). The teachers were

trained on intervention delivery and any necessary data collection procedures for a minimum of one hour and were encouraged to ask any questions they have about the intervention.

The next step in this A-B-C-A-B-C design was to obtain a measure of baseline for each participant, also referred to as the first "A" phase of the design. During this phase, the teacher or paraprofessional placed an activity list as well as materials for four activities within 10 feet of the child with the initial instruction, "Do your work." The number of prompts required for the child to transition from one task to the next was recorded and considered a measure of independent transitioning. The researcher also collected data related to how many items in the series the child completed in order, regardless of the number of prompts received. Prompts were verbal or gestural and the researcher or teacher gave them in a least-to-most method. If the researcher did not collect stable baseline data in four sessions, the researcher continued collecting baseline data until there was stability or the researcher determined that the pattern of the data consists of constant instability.

After the researcher successfully collected baseline data in the "A" phase, the researcher, teacher, or paraprofessional began instruction on the use of binder based visual schedules. The items on each child's schedule were selected after consultation with the child's teacher or paraprofessional and included activities that are already in the participants' current behavioral repertoire, with some of the activities being ones the participant has previously shown a preference for. The binder included one object per page for four pages, with each object representing one of the four activities the child was expected to complete. Each picture consisted of one or more items familiar to the child.

These photographs were taken using a plain white background to eliminate competing stimuli or distractions. The researcher fastened photographs inside sheet protectors within the binder. Each activity had an embedded script describing the activity (e.g., "snack"). The four tasks were ordered by presenting a less reinforcing activity first and increasing in preference to the child until the last activity, which consisted of snack time, an activity that is generally reinforcing to many children. The researcher selected the precise activities on this schedule after meeting with the child's teacher and eliciting feedback on the amount of reinforcement these activities provided to the child based on the teacher's past observations.

The teacher or paraprofessional provided explicit instruction on engaging in tasks and flipping to the next activity page after task completion using a most-to-least physical guidance method and errorless learning procedures. This instruction included verbal task presentation in the expected order of task completion. The child was taught to first, retrieve the binder. Next, the child learned to open the binder to the first page. After that, the child was prompted to gather the materials needed to complete the task. The materials were no more than 10 feet from the child. The child was instructed to complete the task and put the materials back in their designated spot. The child was then taught to go back to the schedule, turn the page, and repeat this process with the next three activities. The teacher then used verbal or full physical guidance (errorless learning) to assist the child through this process for each of the four tasks. This instruction took place for one day, total (two separate training periods each day).

After recording a stable baseline, the participant received two sessions of instruction on the binder based visual activity schedule. Then, the first phase of the

intervention began on the following day (the first intervention phase is also known as the "B" phase). The teacher was close enough, less than 10 feet, to the child to offer verbal or physical prompts, but at least three feet away from the child. The teacher provided the initial instruction to the child, "Follow your schedule." If the child did not complete one of the steps on the task analysis (see Appendix E), the teacher, paraprofessional, or researcher provided a verbal prompt. The researcher or other adult recorded the number of prompts on the data sheet. The fourth activity in the sequence was a preferred, reinforcing activity, a snack. The researcher determined the type of snack after consultation with the participant's teacher. This phase of the intervention continued until there appeared to be a stable baseline or perpetual instability.

After a steady baseline in the "B" phase of the intervention, there were two intervention periods across two days, allowing the participants to receive instruction related to the use of their new intervention, the electronic schedule (training for the "C" intervention phase). The iPad contained the electronic schedule, with four photographs in an album, each representing an activity that was already determined to be in the child's behavioral repertoire. The photographs were identical to the photographs in the binder based schedule, having a white background to eliminate competing stimuli or distraction. The teacher or paraprofessional provided explicit instruction on engaging in tasks and swiping to the next activity photograph after task completion using a most-to-least physical guidance method. This instruction also included a verbal task presentation in the expected order of task completion. The child was taught to first, retrieve the iPad. Next, the child was taught to open the photograph app on the iPad. The child learned to click on the album labeled with their name. After that, the child was taught to select the materials

to complete the first activity from the table in front of them. Similar to the first intervention phase, the materials were no more than 10 feet from the child. The child was instructed to complete the task and put the materials back in their designated spot. The child learned to go back to the schedule, swipe to the next photograph, and repeat this process with the next three activities. The teacher or paraprofessional used verbal or physical guidance (errorless learning) to assist the child through this process for each of the four activities. This instruction continued until there was a stable baseline for this phase or constant instability in the data. The researcher or teacher collected data on the number of verbal prompts delivered and the number of activities within the schedule that the student completed with only verbal prompts.

After the child received instruction on the use of visual iPad schedule, the second intervention phase, also known as the “C” phase, began. Just like during the “B” phase, the teacher was close enough, less than 10 feet, to the child to offer verbal or physical prompts, but at least three feet away from the child. The teacher provided the initial instruction to the child, “Follow your schedule.” As in the “B” phase, if the child did not complete one of the steps on the task analysis (see Appendix E), the teacher or paraprofessional provided a verbal prompt or gestural prompt, also known as least-to-most prompting. The researcher recorded the number of prompts on the data sheet, along with a code describing the type of prompt provided, as previously described. When the student completed the three activities in the schedule, the child’s fourth activity consisted of a snack, which also served as a reinforcer, identical to the procedure in phase "B." This phase of the intervention continued until a baseline of responding was established.

After the “C” phase, the researcher withdrew the intervention for a return to baseline (“A” phase). The conditions were identical to the original baseline (“A”) phase, where students relied on verbal instructions to begin their schedules. The adult listed the activities verbally to the participants and gave them the prompt to begin their schedules. Next, another "B" phase and then a "C" phase was begun, in the same manner as previously described. Overall, the researcher repeated the “A”, “B”, and "C" phases once, for a total of two baseline (“A”) phases, two phases using the binder-based schedule, and two phases using the iPad schedule (A-B-C-A-B-C). The entire data set for measuring prompts during these phases contained approximately 24-26 data points overall, depending on the performance as well as the school attendance of each participant. The data collected consisted of the number of prompts given, the latency of the transitions, and the number of activities within the schedule that the student successfully completed with one or fewer verbal prompts.

Generalization checks were a vital part of the integrity of this study. Skills generalization was measured about one week after the final intervention session (final “C” phase). There were two data points collected over two different intervention sessions. The researcher collected the first generalization data point in tandem with a measure of student preference for the type of schedule they selected as their most preferred. The researcher collected the second data point while the participant followed the other schedule type. The participants were instructed to follow a schedule with two to three novel activities that were already in their behavioral repertoire, with new activity sequences. The researcher selected these new schedules in consultation with each teacher. The methods and measurement for the independent schedule following behavior were

identical to the ones used in the intervention sessions. The researcher or teacher provided prompts following a least-to-most prompting procedure, and the number of prompts given during each activity or transition was recorded in identically the same manner and during the intervention.

After the researcher completed the generalization checks, the researcher sent a letter home with the student thanking them for their participation and explaining how and when their teacher would deliver the tablet, based on information gathered from their teacher regarding the best way to send valuable items home and to thank them for their participation.

Data Analysis

Is a visual activity schedule delivered on an iPad more effective than a visual activity schedule delivered in a binder format in increasing independence in visual schedule activity following for a child with ASD? Is the visual activity schedule delivered on the iPad preferable to the visual activity schedule delivered in a binder format for children with ASD? The hypotheses tested were that a photographic visual activity schedule presented on an iPad would be more effective than a visual activity schedule delivered in a binder format in increasing independence in schedule following behavior as evidenced by decreased prompts from teachers and paraprofessionals. A sub-hypothesis to this was that both formats would be more effective than baseline, which consists of a one-page activity schedule with no instruction on its use. The second hypothesis tested was that students with ASD would prefer a visual activity schedule delivered on an iPad to a visual activity schedule delivered in a binder format.

Data analysis began after at least four baseline data points were collected. The researcher then determined if the data were consistent using visual analysis. The researcher deemed the data consistent if the range of prompts given during each intervention period related to task engagement or task transitioning were within a range of ten. The researcher or teacher recorded all prompts whether the researcher or teacher provided them during an activity or during transitions. The researcher anticipated that students would need many prompts during the baseline phase. However, the data were also considered consistent if they were unstable, as this also shows a pattern of consistency. The data collector recorded the number of activities the student completed in order, from one to four. The researcher also analyzed this data for consistency. The researcher decided if the student completed more than two activities during the baseline phase with four or less total prompts from the teacher or paraprofessional, the student would be ineligible for the study based on lack of need of the intervention, though this did not occur.

Research question one, do visual activity schedules delivered on an iPad increase independence in transitions more than visual activity schedules delivered in a binder-based format for students with ASD between the ages of six and ten years old, was measured by counting the number of verbal prompts given by the teacher, paraprofessional, or other adult between the initial verbal prompt and the beginning of the activity, or between the completion of the activity and the beginning of the next activity (depending on which of the four activities the student is transitioning to). If the adult provided no more than one verbal prompt beyond the initial direction, then the visual schedule was considered effective for that activity sequence. The researcher also

compared the number of prompts given in the baseline phase to the binder-based schedules as well as the iPad format, to see if one or more were more effective than baseline in increasing independence in visual activity schedule following. Using visual analysis, changes in rate, level, and variability of verbal prompts received were analyzed. There was also an analysis of the overall number of activities (maximum of four) completed during the baseline phase to each intervention phase examining changes in rate, level, or variability.

Research question two, do visual activity schedules delivered on an iPad decrease the duration of transition times to a greater extent than a binder-based schedule for students with ASD between the ages of six and ten years old, was measured by timing the latency of the transition, beginning of the first prompt, and ending with the student beginning one activity (for the first activity), or the completion of the activity to the beginning of the next activity (for the next three activities). A single-case statistical procedure known as TauU was used to determine effect size with relation to duration of transitions. TauU is nonparametric and distribution-free, allowing statistical control of a baseline trend, if necessary. Consistent with visual analysis, it works by combining non-overlap in the data with a trend in the data.

Research question three, do visual schedules presented on an iPad or in a binder format provide more immediate reinforcement than relying on an adult's verbal prompts alone, was measured by examining the duration of transitions, as recorded in seconds and minutes, and the number of verbal prompts given to students during each treatment condition. Data related to duration and verbal prompts were compared from the baseline

condition, first treatment condition, and second treatment condition to determine which type of schedule (treatment) was most reinforcing for the student.

Research question four, does the participant's teacher or paraprofessional prefer visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format, was measured using the IRP-15. This measure contains 15 statements related to the acceptability of the intervention. The raters provided responses based on the degree of agreement or disagreement via a six-point Likert-type scale. Higher scores on the IRP-15 indicate greater acceptability of the intervention. The IRP-15 indicates a moderate degree of acceptability if a total score is at least 52.5 (Carter, 2009). The researcher administered the IRP-15 for each treatment condition (binder-based and iPad-based schedules) before and after each intervention was implemented.

Research question five, do students prefer visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format, assessed social validity. The researcher gave each student a simple choice of which schedule they would like to use during the generalization check, post-intervention, and recorded the responses. The researcher asked the students, “Which type of schedule would you like to use? Show me." The researcher presented each student with the two schedules.

For research question six, can the participant generalize independent task transitioning to novel sequences and tasks when using an iPad-based schedule, the researcher conducted two probes. About one week after the last intervention session, the participant received a visual schedule with novel tasks and activity sequences. The researcher recorded the duration of the transition, the number of activities completed, and verbal prompts in the same manner as during the intervention sessions. The first probe

used the preferred schedule, as indicated by the student, and the second probe used the other schedule type.

CHAPTER IV

RESULTS

Research Questions

Q1 Do visual activity schedules delivered on an iPad increase independence in transitions more than visual activity schedules delivered in a binder-based format for students with ASD between the ages of six and ten years old?

For Emily, the level of the data is higher for the binder-based schedule than the baseline level. The level of the iPad schedule is higher than the levels in baseline or the binder-based schedule. Emily's data also point to an increase in trend with a steady rate over time, due to a linear trend line. When examining baseline data, the first baseline had little variability and the second baseline had some variability with data trending upward. This is likely due to her learning how to follow her schedule with verbal prompts. For the binder-based schedule, data also trended upward as she learned the skill of efficiently learning her schedule. However, the iPad schedule did not take as long for her to learn to use efficiently. Independent transitions were high with no variability in both phases utilizing the iPad schedule. The hypothesis tested was supported for Emily (see figure 1).

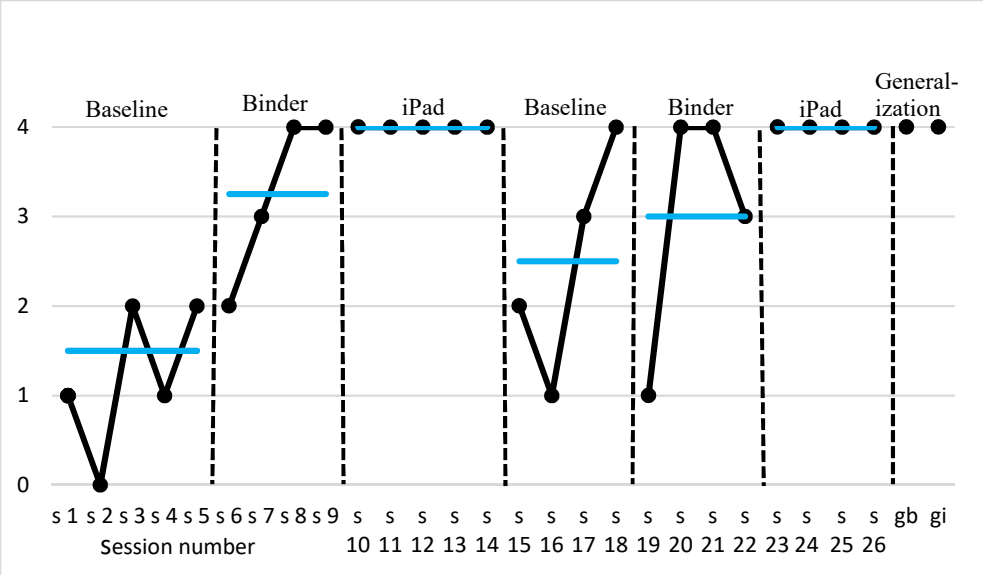

Figure 1. Transitions with one or fewer prompts for Emily

For Vincent, the data levels for both binder-based schedules and iPad schedules were higher than baseline, but the binder-based schedule levels were consistently high while the iPad schedule was lower than the binder-based schedule in one phase. Vincent's data also point to a slight increase in trend with a steady rate over time, demonstrating a linear trend line. For both baseline phases, Vincent had a three out of a total of eight data points that showed variability. Again, there was the effect of learning the schedule simply by listening to the verbal prompts. However, when examining the variability of the data for both the binder-based schedule and iPad schedule phases, there was no significant variability in the data. The hypothesis tested was not supported for Vincent (see figure 2).

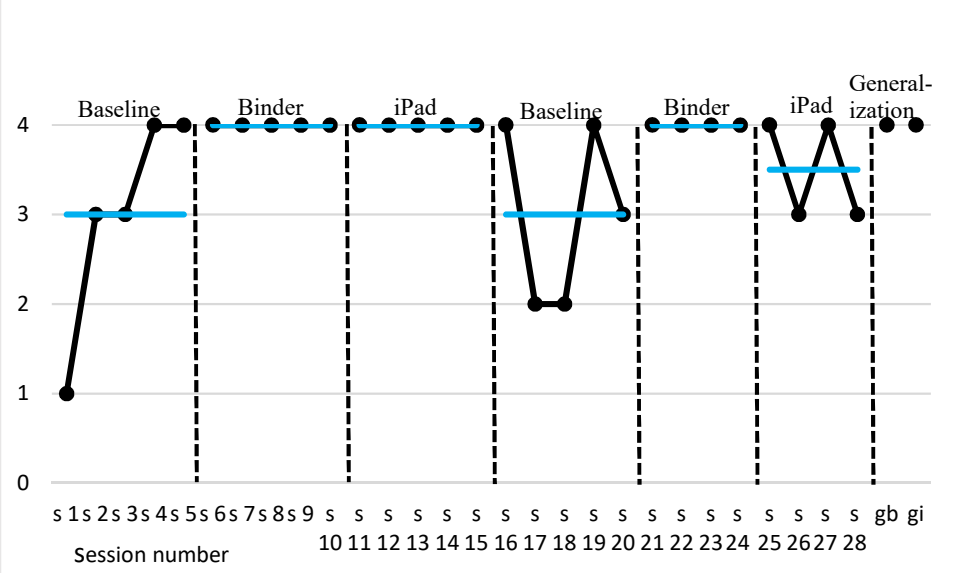

Figure 2. Transitions with one or fewer prompts for Vincent

For Tabatha, the level for the binder-based schedule was higher than the baseline in one phase and slightly lower than the baseline in the second phase. However, the level of data for the iPad-based schedule was higher than both the baseline and the binder-based schedule phases. Tabatha's data also point to an increase in trend with a steady rate over time, displaying a linear trend line. Tabatha was comparatively more affected by observable symptoms of ASD than Emily or Vincent, and the data mirror that notion. The first baseline was not variable, with data points falling between zero and two on the number of transitions she was able to make with only one verbal prompt. However, the last data point of this phase showed an unexpected decrease, but the next phase was introduced to see if she was capable of completing the study using any visual schedule at all. During the return to baseline; however, the data were similarly spread but trending upward, meaning she was learning the skill of schedule-following behavior. During the iPad phases, there was no variability in the data for this student. The hypothesis tested was supported for Tabatha (see figure 3).

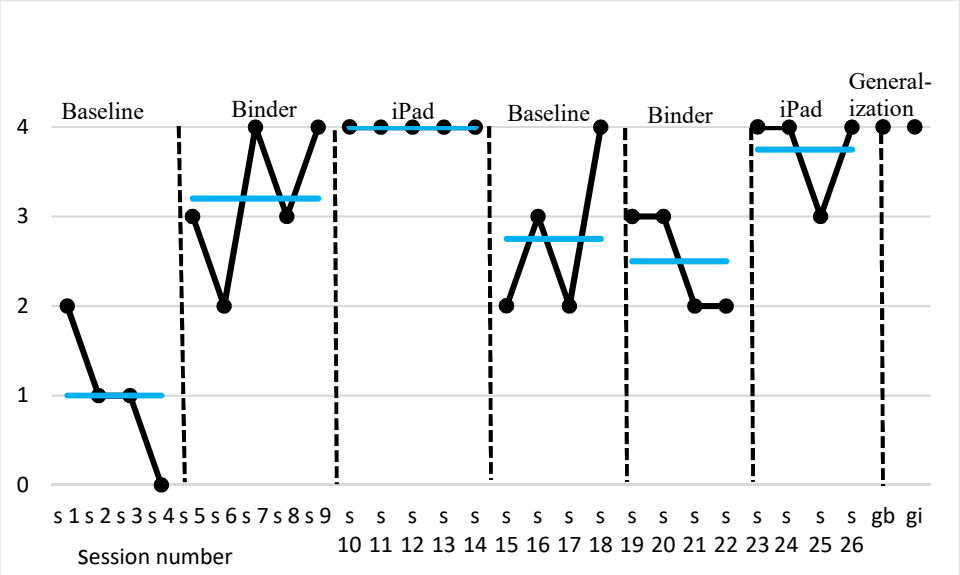

Figure 3. Transitions with one or fewer prompts for Tabatha

Q6 Can the participant generalize independent task transitioning to novel sequences and tasks when using an iPad-based schedule?

All students completed two sessions for generalization checks, consisting of one session for each schedule type. The activities in their schedules were different to assess generalization across activities. All three students demonstrated the ability to transition between four novel activities with one or fewer prompts using the iPad and binder-based schedules during generalization. This confirms the hypothesis for all students, which was that they are able to transition between four novel activities with one or fewer prompts using the iPad schedule.

Q2 Do visual activity schedules delivered on an iPad decrease the duration of transition times to a greater extent than a binder-based schedule for students with ASD between the ages of six and ten years old?

The next hypothesis examined if visual activity schedules delivered on an iPad decreased the duration of transition times to a greater extent than a binder-based schedule for students with ASD between the ages of six and ten years old. The researcher

measured transition duration by calculating the latency (in seconds) between the verbal prompt given to the student and the student completing the activity in the schedule (for all four activities within the schedule). The researcher conceptualized this latency as the total transition time for each session. Thus, the latency was a composite of each transition time between the four activities, so that there was one comprehensive "total transition duration" figure for each intervention session. When measuring latency, a smaller number is desirable because it means a shorter transition duration for the student (see Table 2).

For Emily, the level of the data is lower for baseline than the first binder-based schedule phase. However, in the second baseline phase and the second binder-based phase, the binder-based phase has lower latency (transition time). The level of the data in the phases using the iPad-based schedule is lower than the levels in the baseline and binder-based schedule phases. Emily's data also point to a decrease in trend with a steady rate over time, due to a linear trend line. When examining baseline data, the first baseline had no variability but indicated Emily had learned the visual schedule by using verbal prompts. The second baseline had one data point with variability, but with students with an ASD diagnosis, it is not unusual for them to have an "off" day, and the next two data points were in the expected range. The binder-based schedule also showed decreasing data points due to Emily learning schedule-following behavior. The binder-based schedule data did not show variability overall. The iPad schedule data did not show variability. The hypothesis tested was supported for Emily (see figure 4).

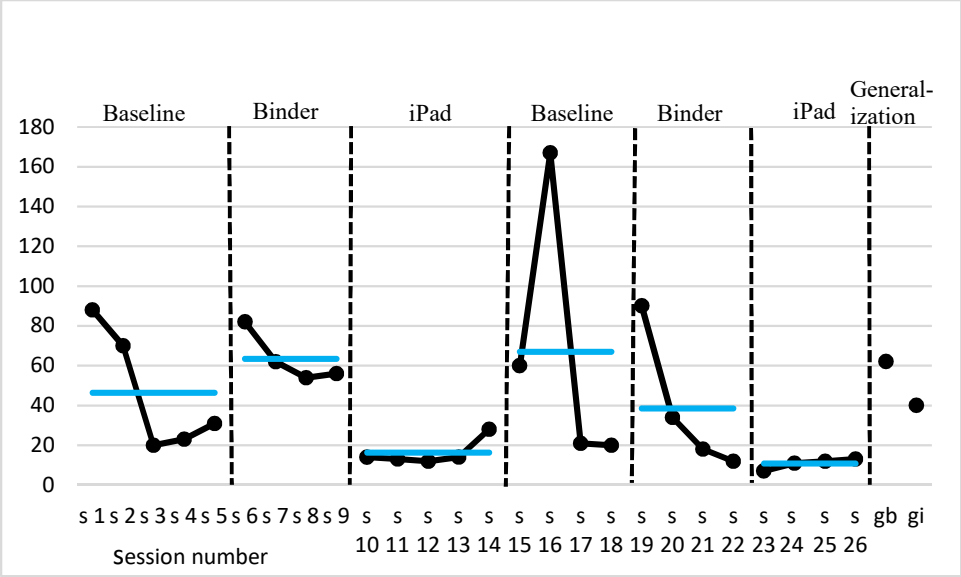

Figure 4. Transition durations in seconds for Emily

For Vincent, the data level for the first baseline phase was higher (longer transition time) than for any of the other phases, at a mean of 60 seconds. When Vincent returned to baseline, however, the mean transition time was 30 second for that phase, likely because he had learned the four activities within the schedule and transition was not as problematic because he knew what to expect. During the first phase of the binder-based schedules and the iPad schedules, Vincent showed a shorter latency when using the iPad schedule. However, the second phases using the binder-based schedule and iPad schedule were similar in level. Vincent's data also point to a decrease in trend with a steady rate over time, demonstrating a linear trend line. For the first baseline, the data did not show variability, but he showed familiarity with the schedule routine based on verbal prompts. The second baseline showed variability, but no outlier data points. The binder-based schedule phases showed only one point of variability out of eight intervention sessions for that schedule. The iPad schedules did not show any variability for Vincent. The hypothesis tested was not supported for Vincent (see figure 5).

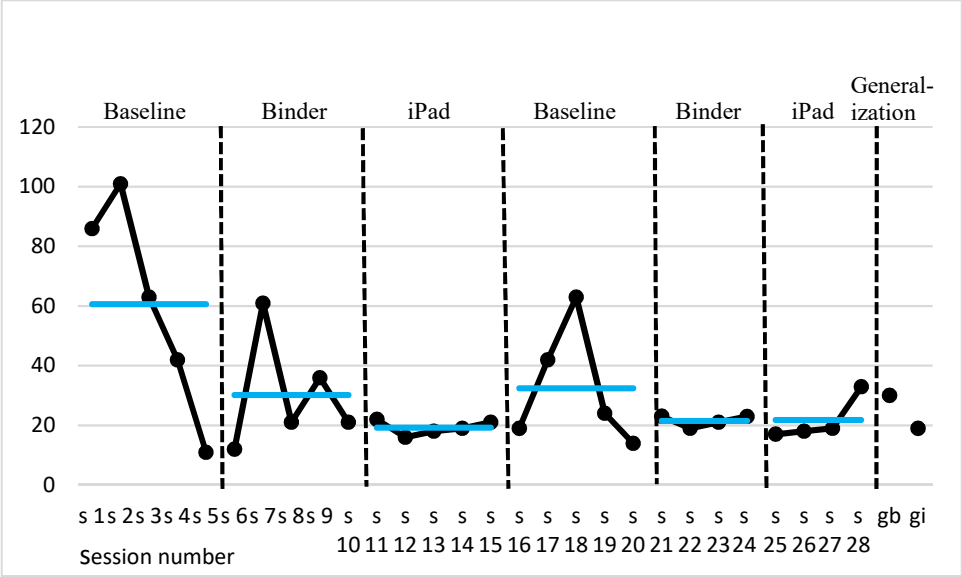

Figure 5. Transition durations in seconds for Vincent

For Tabatha, the level for the first baseline phase was higher than for the second baseline phase or any intervention phases. Latency was greater in this phase. The level of the data for the return to baseline was still higher than both iPad phases but was lower than the first binder-based schedule phase and higher than the second binder-based schedule phase. The level of latency data was lower when using the iPad schedules than when using the binder-based schedule or during baseline. Tabatha's data also point to a decrease in trend with a steady rate over time, displaying a linear trend line. When examining variability, there was no variability in the first baseline phase, and there was one of four data points showing variability in the return to baseline. The binder-based schedule showed no variability but a decrease in latency due to learned schedule-following behavior. The second binder-based schedule phases showed no variability and were stable but decreasing. The iPad schedule phases showed no variability. The hypothesis tested was supported for Tabatha (see figure 6).

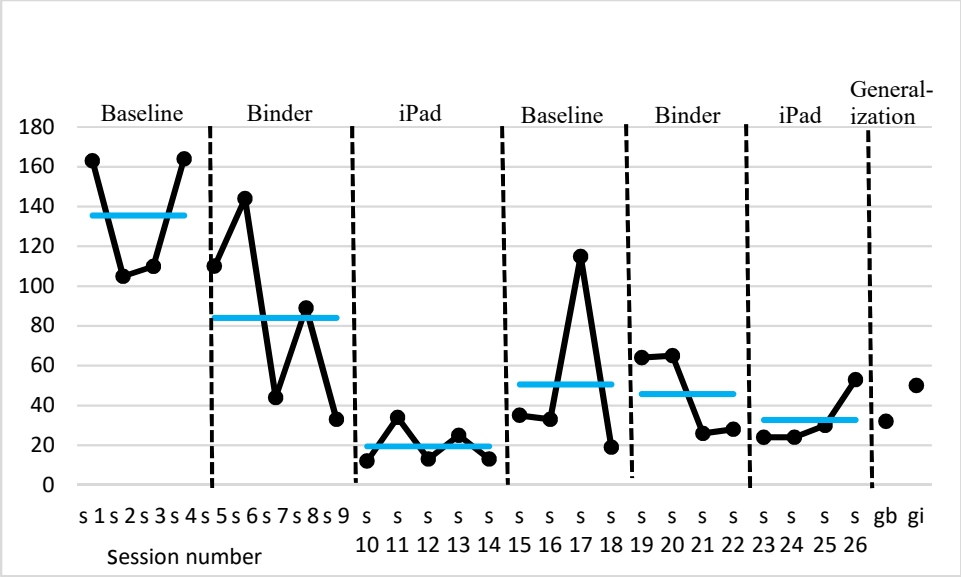

Figure 6. Transition durations in seconds for Tabatha

Q6 Can the participant generalize independent task transitioning to novel sequences and tasks when using an iPad-based schedule?

The researcher held two sessions for latency generalization checks, consisting of one session for each schedule type. The activities in the students' schedules were different to assess generalization across activities. The researcher also collected data for transition duration during generalization. Emily's transitioning in seconds for the binder-based schedule was 62 seconds while the iPad schedule was 40 seconds. For Vincent, the binder-based schedule transition was 30 seconds, and the iPad schedule transition was 19 seconds in duration. Tabatha's duration during transitions was 32 for the binder-based schedule and 50 for the iPad schedule.

Q3 Do visual schedules presented on an iPad or in a binder format provide more immediate reinforcement than relying on a caregiver's verbal prompts alone?

Reinforcement with visual schedules occurs when the latency between the visual prompt and beginning of the activity is consistently less than the latency between the

verbal operant and the beginning of the activity (as in the baseline phases). The hypothesis was that the latency during the iPad and binder formats would be shorter than the latency during the baseline phases (see Table 2). For Emily, the latency for the iPad was shorter than baseline as well as the binder-based schedule when the duration of the activity transitions measured latency in seconds. There was no difference for Emily between baseline latency and the binder-based schedule latency. For Vincent, the binder-based schedule and the iPad schedule had similar latency, which was shorter than baseline latency. For Tabatha, the binder-based schedule produced a shorter latency than the baseline condition of verbal prompts alone, but the iPad schedule produced a slightly shorter latency than the binder-based schedule and a consistently shorter latency than the baseline condition.

Q4 Does the participant's teacher or caregiver prefer visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format?

The Intervention Rating Profile (IRP-15) was used to measure teacher intervention preference as well as social validity. The hypothesis was that the participant's teacher prefers visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format (see Table 1).

Table 1

Pre-intervention and post-intervention questionnaire (IRP-15)

Rater	Binder Pre	Binder Post	iPad Pre	iPad Post
Emily's teacher	86	75	77	90*
Vincent's teacher	88	75	90*	90*
Tabatha's teacher	90*	75	90*	90*

*Maximum score for IRP-15 is 90

Q5 Do students prefer visual activity schedules delivered on an iPad to similar visual activity schedules delivered in a binder-based format?

The researcher collected these data in tandem with the skills generalization check. Before the generalization check began for the first schedule (the students completed generalization sessions for each type of schedule), students were asked to select whether they wanted to use the binder or the iPad schedule (see Table 2). Emily chose the iPad schedule as the preferred schedule type. Vincent selected the binder-based schedule. Tabatha chose the iPad schedule as being more preferred.

Table 2

Hypotheses Confirmed using Visual Analysis

Research Question	Emily	Vincent	Tabatha
Q1: iPad schedule increases independent transitions	Y	N	Y
Q2: iPad schedule decreases the duration	Y	N	Y
Q3: Binder and iPad schedules– immediate reinforcement	Y	Y	Y
Q4: teacher prefers iPad schedule	Y	Y	Y
Q5: student prefers iPad schedule	Y	N	Y
Q6: iPad schedule generalizes to novel tasks/sequences	Y	Y	Y

Quantitative Analysis

Tau-U calculations were made to accompany the visual analysis, combining non-overlap in the data with the trend in the data. The researcher controlled for baseline trend in the Tau-U calculation (see Table 3). The study used the design ABCABC. As such, data points from both A (baseline) phases were combined, data points from both B (binder condition) phases were combined, and data points from both C (iPad condition) phases were combined. Tau-U is typically used to compare a specific treatment phase to the baseline phase. Therefore, to arrive at the Tau-U treatment effect, data points were compared between A and B phases and A and C phases for each student.

Table 3

Tau-U effect sizes for each treatment condition

Participant	Tau-U Binder Independent Transitions	Effect	Tau-U iPad Independent Transitions	Effect	Tau-U Binder Duration	Effect	Tau-U iPad Duration	Effect
Emily	0.31	weak	0.64	moderate	0.13	weak	-0.79	moderate
Vincent	0.52	moderate	0.37	moderate	-0.13	weak	-0.26	weak
Tabatha	0.35	moderate	0.68	moderate	-0.11	weak	-0.58	moderate

For TauU, effect sizes of 0-.31 are considered weak, .32-.84 are considered moderate, and .85-1.0 are considered strong (Parker & Vannest, 2009).

CHAPTER V

DISCUSSION AND CONCLUSIONS

The purpose of the study was to determine the effectiveness of a visual activity schedule delivered on an iPad when compared to a binder-based schedule or no visual schedule at all (the baseline condition). Electronic schedules such as the iPad schedule are thought to be more reinforcing and less cumbersome and stigmatizing than binder-based schedules (Carlile et al., 2013). The hypotheses for each research question centered around using iPad-based schedules to increase independent and effective transitioning between activities for students in schools. The specific constructs measured were the number of independent transitions between activities, duration of transitions between activities, social validity for student and teacher for each type of schedule, and generalization of schedule-use to novel tasks and sequences.

To test the hypotheses pertaining to independent transition, duration of transitions, and generalization, the researcher used a single-case, alternating treatment design with a return to baseline in the middle of the design (ABCABC). Each student served as his or her own control in this single-case alternating treatments design. One advantage of single-case design for participants with ASD points to individual differences associated with students with ASD, making it desirable for the student to serve as his or her own control. The student serving as his or her own control also contributes to the overall study design, allowing the researcher to use an alternating treatment approach to visual activity schedule use, implementing and then withdrawing each intervention. In the current study,

(ABCABC design), the first and fourth phases were baseline phases, the B phases were binder-based activity schedule treatment phases, and the C phases were iPad-based activity schedule treatment phases. The alternating treatment design allowed for multiple treatment phases, two phases of each treatment type, and even included a return to baseline, which may have reduced any carryover effects from the treatment phases. During the return to baseline, the researcher withdrew the visual activity schedules, and the students were given a four-activity sequence orally. After the return to baseline phase ended, the students participated in one more phase of both the binder-based and iPad-based visual activity schedules, and then participated in checks for generalization. In some situations, removal of the intervention may not result in a change where data points are equal to ones from the baseline phase (Riley-Tillman & Burns, 2009). One situation where there may not be a return to baseline in outcome data is with skill-acquisition interventions such as following a visual activity schedule. However, verification of the effectiveness of the intervention may still occur if the intervention withdrawal results in a decreased rate of learning phase (Riley-Tillman & Burns, 2009). Finally, the researcher verified generalization data was accurately collected; one generalization data point was collected for each treatment type by using the visual activity schedules for novel tasks and activity sequences.

The overall results indicate that a visual activity schedule delivered on an iPad shows promise in increasing independence in activity transitions for students with ASD. The iPad delivery of a visual activity schedule also shows potential for decreasing the duration of activity transitions as well as decreasing the latency between the caregiver prompt and the start of the activity schedule. These outcomes lead to some conclusions

regarding the effectiveness of visual activity schedules delivered on an iPad. For one, individual differences exist to some extent. Emily and Tabatha, who appeared to have a greater number of observable ASD symptoms (based on characteristics observed by the examiner during the study) had more desirable outcomes and indicated a preference for the iPad schedule. This finding aligns with other research that students find electronic delivery of instruction more reinforcing due to fewer demands in terms of reduced eye contact and reduced social demands (Stromer et al., 2006; Stromer & Oross, 2000). Vincent, who displayed fewer characteristics of ASD during the study than the other participants, did not show a marked difference in performance based on the type of schedule used. Surprisingly, he indicated a preference for the binder-based schedule. These findings correlate with similar research findings that individual differences may contribute to students' preferences in terms of schedule delivery (Reinert, 2016).

Independent Transitioning Between Tasks

When considering the research question concerning visual activity schedules on an iPad increasing independence in transitions more than visual activity schedules delivered in a binder-based format, the researcher defined independence as transitioning between four tasks with one or fewer verbal prompts. Using visual analysis of the data for each student, the data supported the hypothesis for Emily and Tabatha, but not for Vincent.

During the initial baseline phase, Emily completed two or fewer of the five activities with one or fewer verbal prompts. During the first binder-based schedule phase, Emily completed two to four tasks using the binder schedule. Emily learned the process of using a visual schedule, however, and the last two data points of the first binder phase

show independent transitioning. Emily completed all tasks with one or fewer verbal prompts during the next phase, the iPad schedule phase. After a return to baseline, used to reduce carry-over effects, Emily returned to the binder-based schedule with variable results. Twice, Emily was able to complete all transitions with one or fewer prompts, and twice, she did not. In the second iPad schedule phase, Emily completed all activities with one or fewer prompts. Emily's level of responding was highest when using the binder-based schedule and lowest during baseline. The binder-based schedule showed a weak effect size (.31) while the iPad schedule showed a moderate effect size (.64). In sum, Emily showed a greater amount of independent transition data points when using the iPad schedule.

Vincent did not have a noticeable difference in independent transitioning between the iPad and the binder-based schedules. During the baseline phase, Vincent initially showed the ability to make one activity transition independently, without relying on verbal prompts. He then quickly learned the schedule-following behavior and his independent transitioning increased during baseline. The first treatment phase was initiated despite this situation because it seemed unlikely he would "forget" the learned skill of schedule following. Additionally, Vincent may have also memorized his verbal activity sequence, which also would explain his increase in independence during baseline. During the first binder-based schedule phase, Vincent completed all activities with one or fewer prompts over four intervention sessions (four data points). When the researcher introduced the iPad, Vincent also completed all activities independently, across four intervention sessions. After a return to the baseline, where responding was variable, the researcher reintroduced the binder-based schedule, and Vincent completed

all activities independently. However, when the researcher reintroduced the iPad schedule, Vincent completed three or four activities independently across all four intervention sessions. That is, he required more than one verbal prompt to transition during two of the intervention sessions. Because he later expressed a preference for the binder-based schedule, it is possible that Vincent was less as interested in the iPad. When examining the Tau-U effect size calculations, Vincent showed a moderate effect (.52) for the binder-based schedule and a moderate effect (.37) for the iPad schedule. Overall, Vincent transitioned independently with each type of schedule.

Tabatha was not able to transition without more than one verbal prompt during any of the initial baseline sessions. She completed, on average, one of the four activities in the sequence without more than one verbal prompt for each of her four baseline intervention sessions. During the binder phase, her response was greater but variable. She completed between two and four activities independently. When the researcher reintroduced the iPad schedule, however, her responding was perfect; she independently transitioned between all four activities on all four intervention sessions. There was a return to baseline, where her responding was variable, and then the binder-based schedule was reintroduced. During this phase, her responding decreased, as she completed between two and three transitions independently. When the researcher reintroduced the iPad schedule, however, her response increased, and she completed three or four activities (usually four) independently during all four intervention sessions. The effect sizes showed a moderate effect (.35) for the binder-based schedule and moderate but higher (.68) when using the iPad. Tabatha showed the best responding to the iPad schedule when measuring independent activity transitioning.

Consistent with findings in the literature comparing electronic visual schedules to non-electronic visual schedules, such as binder-based schedules, outcomes are variable and may largely depend on individual differences (Banda & Grimmett, 2008; Koyama & Wang, 2011; Reinert, 2016). In the current study, schools had identified all student participants with ASD through criteria established by the Individuals with Disabilities Educational Act (Individuals with Disabilities Education Act, 2004). Data interpretation can be complex due to individual differences in behavior. Emily and Tabatha showed more symptoms in greater severity than Vincent, according to observations during the intervention sessions. It is interesting that Emily and Tabatha showed greater independence in transitions using the iPad schedule, whereas Vincent showed similar outcomes on both of those measures regardless of the type of visual schedule used. In general, all students had at least a moderate response to the iPad-based intervention, whether measuring Tau-U effect size or using visual analysis. The responding observed in the current study underscores Reinert's (2016) findings that students with ASD respond to a visual activity schedule on an iPad. The data supported the hypothesis of students responding with greater independent transitioning when using an iPad-based schedule for Emily and Tabatha.

Duration of Transitions and Latency

Duration of the actual transitions between activities was measured in seconds and summed to produce one total number representing seconds for each intervention session. The duration sum helps to answer two research questions: Do schedules delivered on an iPad decrease the duration of transition times to a greater extent than binder-based schedules? Which type of schedule provides more immediate reinforcement (by a

decreased duration of transitions) when compared to relying on a caregiver's verbal prompts alone?

Emily's transition times during the baseline phase began high but eventually stabilized to a shorter amount of time as she learned the schedule-following behavior. When the researcher reintroduced the binder-based schedule, Emily showed an increase overall in transition duration. When the researcher reintroduced the iPad schedule, Emily showed shorter durations during the first intervention phase. After a return to baseline, which showed variable transition times, the researcher introduced the binder-based schedule. Emily showed a shorter overall transition duration when using the binder-based schedule, in comparison to the first baseline phase and the first binder-based phase. When the researcher reintroduced the iPad schedule in the next phase, the transitions became quick again, showing reduced transition times. Tau-U effect sizes for Emily showed a weak effect for the binder-based schedule (.13) and a moderate effect for the iPad schedule (-0.79). Emily transitioned much more quickly when using the iPad schedule. When studying latency, Emily showed a significant difference between using a visual schedule and not using a visual schedule, but only when considering the iPad schedule.

Vincent also showed a long latency between the initial verbal prompt and activity completion during the first part of the baseline. However, Vincent, like Emily, began to learn schedule-following behavior meaning the transition durations began to decrease across the baseline phase. When the researcher introduced the binder-based schedule, Vincent showed a variable response, appears to have only slightly shorter transition durations, according to the visual analysis of his data. When the researcher introduced the iPad schedule, his responding became consistent, and the transitions became shorter.

After a return to baseline, which showed variability in the amount of duration for transitions, the researcher reintroduced the binder-based schedule. Interestingly, this time, Vincent responded to the binder-based schedule with shorter transitions, similar to his responding with the iPad schedule. When the researcher reintroduced iPad schedule, Vincent showed a similar rate of responding, which was quickly transitioning with short duration times. Vincent's Tau-U effect sizes for the binder-based schedule were weak (-0.13) and for the iPad schedule were weak (-.26). The effect sizes were likely skewed by his ability to learn the schedule-following behavior over time, resulting in an artificially high return to baseline. In some complex situations such as the design of the current intervention, it is difficult or possible to return to original baseline levels, but a partial return to baseline may show that the intervention is partially responsible for the outcome data phase (Riley-Tillman & Burns, 2009). Schedule-following behavior was a learned skill for all three participants, though a carryover effect could also explain the reason the data did not return to pre-intervention levels phase (Riley-Tillman & Burns, 2009). Without the return to baseline, Vincent responded well to both the binder-based schedule and the iPad schedules, especially when compared to the initial baseline. When studying latency, he showed lower transition durations for the visual schedule phases when compared to baseline.

Tabatha's baseline suggests long transitions between activities. When the researcher introduced the binder-based schedule, Tabatha's duration times decreased. When the researcher introduced the iPad schedule during the next treatment phase, however, her duration times decreased significantly. That is, she responded very well to the iPad schedule and made quick transitions between activities. The return to baseline

showed some learned schedule-following behavior, as the transitions were shorter when compared to the initial baseline, but the main purpose of the return to baseline was to reduce carryover effects. When Tabatha began following the binder-based schedule again, she responded in a similar way as she did in the previous phase, which was a return to baseline. Tabatha was likely learning to follow the activity sequence to some extent without heavily relying on the activity schedule. When the researcher introduced the iPad schedule again, her transition durations became shorter. Tabatha's effect sizes for Tau-U showed a weak effect for the binder-based schedule (-0.11) and a moderate effect for the iPad schedule (-0.58). She responded well to the iPad-based schedule but also demonstrated the ability to learn to follow either type of schedule over time. When examining latency, Tabatha showed a significant difference between using a visual schedule and not using a visual schedule.

The hypothesis, visual activity schedules delivered on an iPad significantly decrease duration transitions as compared to binder-based schedules, was supported by the data for all three students. Although there were no studies measuring transition duration between activities for students with ASD, these data are consistent with findings in the literature comparing electronic visual schedules to non-electronic visual schedules, such as binder-based schedules differences (Banda & Grimmett, 2008; Koyama & Wang, 2011; Reinert, 2016). When examining latency between the baseline transition durations for each student and either type of binder-based schedule, the hypothesis that a visual activity schedule would decrease the duration of transitions more than no schedule at all, was supported for Vincent and Tabatha and mostly supported for Emily.

Social Validity

The researcher examined whether the participant's teacher prefers visual activity schedules delivered on an iPad to visual schedules delivered in a binder-based format. The hypothesis was that visual activity schedules delivered on an iPad would be preferred by the teacher. Each teacher had an opportunity to use each type of schedule with each student at least one time. Emily and Vincent had the same teacher, who was asked to fill out each questionnaire separately for each student. The IRP-15 (Witt, et al., 1984) questionnaire was used to measure preference. Emily's teacher rated the post-intervention acceptability of the binder-based schedule with 75 out of 90 points, while she gave the iPad schedule 90 out of 90 possible points, thus supporting the hypothesis of iPad preference. For Vincent, the teacher gave the binder-based schedule 75 out of 90 points and the iPad schedule 90 out of 90 points indicating a preference for the iPad schedule for Vincent. Tabatha's teacher also rated the binder-based schedule a 75 out of 90 points and the iPad schedule 90 out of 90 points. Thus, the data supported the hypothesis stating that teachers would prefer the iPad schedule to the binder-based schedule for all students. Teachers preferred the iPad-based schedule, possibly due to ease of use and positive outcomes with their more affected students. Emily's teacher, while observing an iPad-based schedule session, excitedly reported that she had been previously unaware that Emily was capable of completing a four-activity sequence without help from a teacher or caregiver. Finally, collecting social validity data from teachers and students added to the robustness of the study because it the best interventions are the ones used with fidelity. Results highlight researchers' findings, that binder-based schedules have less social validity because they are seen as difficult and time intensive to prepare (Carlile et al.,

2013). The high social validity for teachers also underscores the findings of Schwartz and Baer (1991) which suggest interventions are more likely to be implemented with fidelity if the interventionists view them as important, effective, and easy to prepare.

The researcher was also interested in determining which type of schedule the students preferred to use. The hypothesis was that all students would prefer the iPad schedule. When all phases of the study were completed, during the checks for generalization, the students were presented with each type of schedule and asked which one they wanted to use. Emily and Tabatha chose the iPad schedule, and Vincent chose the binder-based schedule. Therefore, the hypothesis was confirmed for Emily and Tabatha only. Additionally, Emily and Tabatha showed a preference for the iPad-based schedule while Vincent chose the binder-based schedule.

These findings are similar to Reinert (2016), where individual differences were present. Reinert (2016) investigated the effectiveness of using an iPad to teach visual activity schedule following (for play activities) to preschoolers with ASD. When preferences were measured, Reinert found two children preferred the iPad-based schedule while one child preferred the paper-based schedule, highlighting individual differences. Of note, Reinert measured transitions between play or leisure skills for pre-school students. Older students face additional expectations and must complete less preferred activities such as literacy and numeracy skills, for which transitions from a less preferred activity to a more difficult activity may present additional challenges.

Other researchers found positive outcomes in response to electronically delivered interventions for students with ASD. One literature review concluded that computer time is reinforcing to students and integrating visual activity schedules with technology could

help expand skills already within the student's repertoire (Stromer et al., 2006). Other investigators found that technology helps those with developmental disabilities learn cognitive and literacy skills (Stromer & Oross, 2000).

Generalization to Novel Sequences and Tasks

Finally, the researcher studied data for independent task transitioning to novel sequences and tasks when using an iPad-based schedule. The hypothesis stated that the students would be able to generalize their independent schedule-following behavior to new tasks and sequences. To accomplish this, the researcher presented the students with a schedule similar to the one they had been using, but the activities were slightly different and in different sequences. The students' teachers assisted with selecting tasks that were within the students' abilities but were tasks they had not seen before. Students showed generalization when they independently followed a four-sequence activity schedule with one or fewer verbal prompts. For example, Tabatha began matching sight words to vowel sounds, and Emily began a fill-in-the-blank writing activity. Out of the four tasks, three were new tasks replacing previously learned tasks in the schedule, arranged in a novel sequence. The hypothesis as confirmed for all students. Emily used the binder-based schedule as well as the iPad schedule to transition between activities with one or fewer verbal prompts. Vincent completed all activity sequences in each type of schedule with one or fewer verbal prompts. Tabatha also completed all activities in each schedule with one or fewer verbal prompts. It is notable, during the generalization period, how all students completed all task sequences without the need for verbal prompts, which may indicate improved schedule-following behavior. Finally, generalization to novel sequences and tasks points to schedule use as a versatile tool to elicit schedule-following

behavior and suggests some students may have sufficient cognitive flexibility to be able to generalize this skill. Spriggs et al. (2015) found that students generalized tasks learned through video modeling. Spencer et al. (2014) found that for evidence-based interventions which have shown effectiveness in students with disabilities, there are common elements such as direct instruction, behavior modification, and an element of visual support. Thus, the students' ability to learn schedule-following behavior and later generalize that skill underscores Spencer et al.'s findings.

Diversity

A positive characteristic of this study includes diversity in participants, though each was an elementary-aged student with an educational diagnosis of ASD. The study focused on three participants, two of whom were female. Including female participants in the current study helps to address the paucity of research using female students with an educational diagnosis of ASD. In a review and analysis of thirty scholarly studies, researchers found a disparity in gender, with few studies including interventions with female students with ASD (Knight et al., 2015). There was a lack of studies including females with autism, even when accounting for the fact that fewer females are diagnosed with autism. Researchers noted that future research should utilize female students with ASD to investigate how individual differences may present with diverse and under-represented groups of students (Knight et al., 2015).

Researchers also found a lack of studies describing autism in participants as severe (Knight et al., 2015). In this study, Emily and Tabatha, the two female participants, showed emotional lability, stereotyped behavior, and a lack of expressive and sometimes receptive communication. Additionally, Vincent was part of an under-

represented minority group, contributing to the robust characteristics of the participants in this study. The present study contributes to advancing research on these groups of students. For Tabatha, the researcher observed stereotypical behavior such as hand flapping and echoics, which ceased when the researcher provided the student with the schedule to follow, which she finished quickly, and then resumed stereotypical behaviors. This highlights the findings of researchers that visual activity schedules aid in activity transitioning and reduce stereotypical behaviors for students with ASD (McClannahan & Krantz, 1997).

Consistent with Reinert's 2016 findings, each student who had experience with some previous schedule-following behavior was able to follow an iPad-based schedule. In a dissertation study, Reinert (2016) studied the effectiveness of using an iPad to teach visual activity schedule following for leisure activities) to preschoolers with ASD. One similarity of the current study and Reinert's study is the inclusion of measures of social validity for both the iPad-based schedule and the paper-based activity schedule. Another similarity between Reinert's study and the current study is that social validity data were gathered by performing a choice assessment.

Reinert's study and the current study shared some similarities, but had differences, as well. They differed in that Reinert used an iPad, with a specific app developed by Reinert herself, to compare the iPad schedule to a binder-based schedule. The current iPad-based activity schedule used the photo gallery app, which comes included with all iPads. Reinert's study and the current study were similar in that the iPad schedule consisted of one activity picture per page. Both Reinert and the current researcher measured the total number of activities completed independently during a

session, as well as the participants' independently completed activity schedule components. Reinert's study used a multiple baseline across participants design, while the current researcher used three separate ABCABC designs, one per participant. Reinert's findings showed all three participants had a significant increase in both completed activities during the iPad-based activity schedule and increases in the percentage of correctly completed components, while the current study only showed the iPad as having greater outcomes for Emily and Tabatha. However, similarly, when Reinert measured schedule preferences, two children preferred the iPad-based schedule while one child preferred the paper-based schedule, the same ratio as in the current study.

Reinert's study showed that an iPad based visual activity schedule, using a specific app, may be effective for increasing independent in transitioning in leisure or play skills with preschoolers with ASD. However, Reinert's study differed from the current study in that Reinert's study used a very young, narrow age range, a private school, and the findings are specific to an app developed by Reinert that may not be widely available. Reinert's study also did not measure times between the end of one activity and the beginning of the next (transition duration), which can be a critical indicator of success in activity transitioning behavior. The current study focused on students within the largest population of students receiving special education services (for ASD), spanning kindergarten through the fifth grade in a public school setting. The current data also found transition times decreased with the use of a visual activity schedule intervention of either type. Finally, Reinert measured transitions between play or leisure skills for pre-school students. However, the current study included participants of varying ages, given that older students face additional expectations and must complete

less preferred activities such as literacy and numeracy skills, for which transitions from a less preferred activity to a more difficult activity may present additional challenges.

Implications for Practice in Schools

This study, which measured independent transitioning, latency, generalization, and schedule preference for students as well as teachers, yielded valuable information which has the potential to be used in educational planning. First, the visual activity schedules, regardless of whether the researcher delivered them in a binder-based or iPad format, were more effective than baseline in independent transitioning and reduced latency. The baseline phases in the current study consisted of participants being given a four-activity sequence verbally. Next, given the educators in this study told the researcher, anecdotally, that they didn't know much about using visual activity schedules, more education should be geared towards general education and special education teachers in the field of visual schedule research and the appropriateness of visual activity schedules as an intervention for activity transition for students with ASD. Considering that many students are subject to inclusion/mainstreaming practices, an intervention such as the iPad visual schedule, that aids students in completing activities independently, should be considered for classroom use for students with ASD (Lindsay, 2007).

Additionally, students have individual differences and preferences when it comes to visual activity schedule use just as they have individual presentations of ASD and differing levels of intellectual ability (Banda & Grimmett, 2008; Koyama & Wang, 2011). Teachers should be trained to recognize the differences between students within the category of ASD and should consider teaching students to follow an electronic visual schedule as well as a paper-based or binder-based schedule delivery. After learning how

to follow each type of schedule, students may show a clear preference or effectiveness of one type of schedule over another. In the current study, students who exhibited a greater number of symptoms of ASD showed more favorable outcomes using an iPad-based schedule than when using the binder-based schedule. A visual activity schedule presented in an electronic format may also be desirable for teachers who can easily change and rearrange activities within the schedule, using pictures from the students' actual classrooms to represent the activities, reducing the need for extensive symbolic interpretation for students who are acquiring and practicing activity schedule-following behavior. Computers and technological devices are reinforcing to many students with ASD, and schools can harness this quality when implementing a visual schedule program to target independence in transitioning (Stromer et al., 2006; Stromer & Oross, 2000).

Visual activity schedules are flexible enough in nature that teachers can incorporate activities specific to student goals (e.g., verbal behavior goals) into the schedule. For example, according to DSM-5, which also serves as a guideline for many educational diagnoses of ASD, social communication deficits are apparent in students with ASD. For these students who are working on communication skills, teachers may want to incorporate verbal operants into the creation and use of the visual activity schedule. Teachers may want to consider having students mand, also known as making direct requests, for their electronic visual schedules. An activity within the visual schedule could also prompt and require the student to mand for something desired. A tact is similar to "labeling something," and if this occurs spontaneously during visual activity schedule use, and a teacher observes this verbal behavior, the teacher could provide social praise or other rewards. Intraverbals include one person saying something based on

what another person has said. Teachers who observe a student completing a visual activity schedule sequence may ask what the student is doing, ask if the student is finished, or prompt the student with any number of questions eliciting responses. Finally, there is echoic verbal behavior. This occurs when the student repeats exactly what the teacher or another person has said. One example of using this type of behavior might occur when the student is first learning to use the visual activity schedule. The teacher could label each activity and provide social praise when the student repeats the names of the activities. By using verbal operants, students can receive the benefits of independent schedule following behavior, effective transitions, while retaining sufficient opportunities to practice verbal communication skills. Thus, the student is largely independent in following an activity schedule and transitioning, so that the teacher is free to check on the student and provide verbal communication as the teacher's availability allows.

In addition to incorporating verbal behavior tasks into the student's visual schedule, there are, of course, many other ways to utilize this intervention in both the self-contained as well as inclusive, or general education, classrooms. Visual activity schedules can include four tasks, as those in the current study did, or many more tasks. They are flexible enough to add activities and lengthen the activity sequence or to take away activities. As long as the activities are within the student's behavioral repertoire, they are appropriate for inclusion in the visual activity schedule (Koyama & Wang, 2011; McClannahan & Krantz, 2010). As was previously discussed, teachers in general education classes with students with ASD can utilize visual schedules to provide independence for students as they learn and complete activities alongside their more typical peers. Teachers in self-contained classrooms using visual activity schedules may

see a decrease in duration of transitions and a greater amount of independence, which would likely increase a student's time-on-task and, therefore, educational progress (Koyama & Wang, 2011). Whether the visual activity schedules include activities geared towards a specific skill, such as verbal communication or the schedule focuses on concrete task completion, and whether the schedule includes many activities or just a few, it is a flexible tool to create independence in student transitioning within the classroom.

Limitations

The present study had some limitations, including threats to internal and external validity. Internal validity threats include the researcher beginning data collection for the study in May, a few weeks before school ended for the summer. The researcher did not begin data collection sooner because of the amount of time required to apply and received approval from the university IRB, the school district IRB, and parent consent (Table 4). Because school was about to end for the summer break, there was a limited amount of time to conduct the study before needing to finalize the study and complete generalization checks. The study was not extended to the following year due to concerns about the potential for history effects, which are an internal validity threat to single-case design (Riley-Tillman & Burns, 2009). For example, there were planned changes to the students' environments for the next school year in terms of teachers and classrooms. Additionally, each student may have had different experiences while away from school resulting in increased or decreased academic and behavioral skills. Given these limitations, if the data appeared to be unstable in one phase, rather than automatically extending the phase, the researcher analyzed the data points and determined whether or

not there was enough stability or, in some cases, a pattern of instability sufficient that the researcher could move into the next phase of the study confidently.

Table 4

IRB approvals and data collection timeline

Date	Progress Towards Data Collection
2/7/2018	Applied to the University of Northern Colorado IRB
3/30/2018	Received IRB approval from the University of Northern Colorado
3/30/2018	Applied to Poudre School District IRB
4/3/2018	Received letter of rejection from Poudre School District IRB
4/4/2018	Applied to Greeley Evans Weld County School District 6 IRB
4/17/2018	Received IRB approval from Greeley Evans Weld County School District 6
5/2/2018	Received consent forms for three students; Received assent and began data collection
5/22/2018	Finished all data collection

Another threat to internal validity included the learning of the skill of schedule-following behavior, as seen by a baseline that showed increases in independence and creases in latency before the researcher implemented interventions. Because the students were set up with a schedule of activities that are in their behavioral repertoire, all they had to learn was to follow a set schedule. The students likely discovered during baseline that their schedules would consist of four activities they knew well. Therefore, at times, the students showed a trend toward independence and decreased latency even during the

baseline phases. Further, the A-B-C-A-B-C design may have produced different results if it had been A-C-B-A-C-B, rather, if the researcher used the iPad as the first of the alternating treatments.

Another internal validity threat with the learned schedule-following behavior was the return to baseline as well as carry-over effects from one phase to the next. First, in studies such as the current one where students are learning an acquired skill, such as schedule-following behavior, it may be difficult or impossible for the student to return to original baseline functioning. In this instance, a partial return to baseline may still show experimental control, meaning the intervention is at least partially responsible for the outcome data phase (Riley-Tillman & Burns, 2009). In a design involving some amount of skill acquisition, consumers may interpret data in terms of comparing the trend in baseline to the trend in the intervention phases phase (Riley-Tillman & Burns, 2009). Students who were doing well using the verbal schedule (baseline phase), may have generalized those verbal instructions to the binder-based schedule, and when in the binder-based schedule phase, effects may have been carried over to the iPad-based schedule phase. To prevent or reduce carry-over in single-subject design, researchers often incorporate a return to baseline in an A-B-A-B design phase (Riley-Tillman & Burns, 2009). Carryover effects were most likely mitigated by the return to baseline in the middle of the study, but it is possible there were some carry-over effects. As such, the return to baseline was partial, but not complete. Counterbalancing the design may have reduced order effects in some instances; returning to the baseline condition after each intervention phase may also have reduced order effects (Riley-Tillman & Burns, 2009).

As such, future research may change the design from A-B-C-A-B-C to A-B-C-A-C-B or A-B-A-C-A-B-A-C.

An additional internal threat to the current study involves the use of both visual and quantitative analysis. While quantitative analysis, including the Tau-U statistical method, can yield an additional process of data interpretation, it is not without limitations. Some limitations are the terminology associated with Tau-U in published literature is inconsistent, results based on pure arithmetic can produce difficulties in interpreting results, particularly when controlling for baseline trend, and graphing Tau-U outcomes visually can be often unclear (Brossart, Laird, & Armstrong, 2018). Finally, the biggest limitation of Tau-U was found by researchers when study outcomes showed Tau-U effect sizes as being weakly correlated with visual analysis, the cornerstone of single-case design data interpretation (Brossart et al., 2018). In the current study, the return to baseline, where data were inconsistent with the original baseline due to schedule-following behavior skill acquisition, Tau-U results may have been skewed. However, when interpreting using visual analysis as well as outcome data from Tau-U, and knowing these stated limitations, consumers of research may use the additional data to assist in their conclusions.

Threats to external validity appeared as well. One limitation of the current study is generalizability. Consistent with similar studies, individual differences exist in students with neurodevelopmental disabilities. Therefore, to say that iPad schedules always increase independent activity transitioning and decrease latency and duration of transitions may be fallacious. However, the results of this study add to the body of research suggesting interventions delivered electronically may be reinforcing to and aid

students with ASD in completing activities such as the ones used in the iPad schedules in the current study (Burckley, et al., 2015; Cihak, 2011; Kaye, 2000; Koyama & Wang, 2011; Reinert, 2016; Spriggs et al., 2015).

Finally, interpretation differences in data interpretation is a threat to external validity. Visual analysis is known to be subjective in nature, although steps were taken to do multiple types of data analysis such as level, trend, variability, and latency. In addition to the visual analysis, the researcher employed Tau-U, a statistical calculation that analyzes non-overlapping data in terms of its relation to baseline data. However, there were some concerns. Tau-U is designed to compare two phases. Therefore, the baseline phases were combined in the Tau-U calculation and compared to the combined B phases. The researcher then compared the combined baseline data to the combined C phases. As previously mentioned, the return to baseline was not a pure baseline, as the schedule-following behavior was learned, resulting in the second baseline data points significantly differing from the natural baseline data points. This was a limitation because the second baseline appeared elevated, thus when the researcher performed the TauU calculations, the baseline data were overall higher than before any intervention at all, resulting in an underestimate of the effect size of the intervention.

Future Research

Future studies may incorporate criteria to meet evidence standards without reservations. According to What Works Clearinghouse, there are five criteria for a single-case design to meet evidence standards without reservations (Kratochwill et al., 2010). The study must systematically manipulate an independent variable, and each outcome variable must be measured systematically across time by more than one examiner (inter-

rater agreement for 20% of data points). Additionally, the study must include three attempts to demonstrate an intervention effect at three different points in time or three different phase repetitions, each phase must have a minimum of three data points, and if the study is an alternating treatment design, needs five repetitions of the alternating sequence.

Future single-case research may also include five or more participants, to further study the individual differences inherent in individuals with ASD who are participating in intervention studies. A study that includes more data points may be beneficial in detecting which phases show true stability and which phases show a pattern of instability. Instead of a return to baseline which includes three to five data points, more baseline phases between the treatments might be advantageous, even if they only consist of 2-3 data points each. If a researcher uses this design, Tau-U should only make pairwise comparisons between the original baseline and treatment phases. Further, the use of a counterbalanced design, such as A-B-C-A-C-B, or using a return to baseline phase after each intervention phase, may reduce order effects in future designs of this nature (Riley-Tillman & Burns, 2009). Although the researcher and teacher consulted to determine the number of activities to include in each child's schedule, the researcher underestimated the ability of the students to complete the schedule. Therefore, future studies should include a great number of activities within the visual activity schedules.

Other conceptualizations of future research directions include studying the same variables within a larger study, using a group design to measure these variables, or using a design that controls for order effects. Lastly, examining other dependent variables such

as aggressive behaviors, improved academic outcomes, or greater work completion using different types of schedules may produce valuable outcome data in the future.

Conclusions

There are many takeaways from this study, previously explained. In sum, iPad-based activity schedules, when created where each activity is more reinforcing than the last, may help increase independent transitioning (with one or fewer prompts) and decrease the duration of activity transitions for some students. Research indicates that interventions have a more successful outcome when seen as effective, important, and simple to implement (Schwartz & Baer, 1991). Teachers may be more likely to use the iPad schedule with fidelity because iPad schedules were shown to be preferred by teachers. Individual differences exist among students with ASD, so a student who continues to show difficulty in transitioning using an iPad-based schedule may benefit from a binder-based or paper-based schedule, particularly if that student is considered higher-functioning on the ASD spectrum. Further, iPad schedules can be worth the investment, since schools are embracing technology and many pupils have access to iPads or other one-to-one digital services (Blikstad-Balas & Davies, 2017). Researchers found positive outcomes when examining the process of teaching and learning in terms of the availability in schools of one-to-one devices such as the iPad (Blikstad-Balas & Davies, 2017). Finally, when using Binder-based visual activity schedules as well as iPad-based visual activity schedules, students are typically able to generalize the schedule-following behavior to novel tasks and sequences.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL
UNIVERSITY OF NORTHERN COLORADO

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

DATE:	March 30, 2018
TO:	Leisha Tompkins, M.C.P.
FROM:	University of Northern Colorado (UNCO) IRB
PROJECT TITLE:	[1195084-3] COMPARATIVE EFFECTS OF AN ELECTRONIC VISUAL ACTIVITY SCHEDULE ON YOUNG CHILDREN WITH ASD IN INCREASING INDEPENDENCE IN ACTIVITY TRANSITIONING
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVED
APPROVAL DATE:	March 30, 2018
EXPIRATION DATE:	March 30, 2019
REVIEW TYPE:	Expedited Review

Thank you for your submission of Amendment/Modification materials for this project. The University of Northern Colorado (UNCO) IRB has APPROVED your submission. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on applicable federal regulations.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of March 30, 2019.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

If you have any questions, please contact Sherry May at 970-351-1910 or Sherry.May@unco.edu. Please include your project title and reference number in all correspondence with this committee.

Generated on IRBNet

Please remember to add page numbers to your consent document prior to using them in participant recruitment and data collection.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Northern Colorado (UNCO) IRB's records.

APPENDIX B

INSTITUTIONAL REVIEW BOARD APPROVAL
GREELEY EVANS WELD COUNTY SCHOOL DISTRICT 6

Greeley-Evans
WELD COUNTY SCHOOL DISTRICT 6

Weld County School District 6
Academic Achievement
1025 Ninth Avenue
Greeley, Colorado 80631
970-348-6000

Dr. Stacie Datteri
Assistant Superintendent
of Academic Achievement

April 17, 2018

Ms. Leisha Tompkins,

Greeley-Evans School District 6 has approved your application to conduct the research project entitled *Comparative effects of an electronic visual activity schedule on young children with ASD in increasing independence in activity transitioning* at Monfort Elementary School. We look forward to hearing the results of the study when you are finished.

Sincerely,

Dr. Stacie Datteri,
Assistant Superintendent
of Academic Achievement

APPENDIX C

DATA COLLECTION SHEET

Date:

Participant's ID:

Type of Visual Schedule Being Used:

Number of Activities on Schedule:

Description of Activities on Schedule:

Transition Time in Seconds:

Activity 1 – Start: Stop: Total Time:

Activity 2 - Start: Stop: Total Time:

Activity 3 - Start: Stop: Total Time:

Activity 4 – Start: Stop: Total Time:

Verbal Prompt Delivery (Number of Verbal Prompts Provided)

Activity 1 –

Activity 2 –

Activity 3 –

Activity 4 –

APPENDIX D

SOCIAL VALIDITY STUDENT DATA COLLECTION SHEET

“Which type of schedule did you like more? Show me.”

Trial 1 – Electronic Schedule

Binder Schedule

Trial 2 – Electronic Schedule

Binder Schedule

Trial 3 – Electronic Schedule

Binder Schedule

APPENDIX E

TASK ANALYSIS FOR BASELINE DATA COLLECTION

____ (a) researcher has list of activities for participant

____ (b) iPad is not present

____ (c) binder schedule is not present

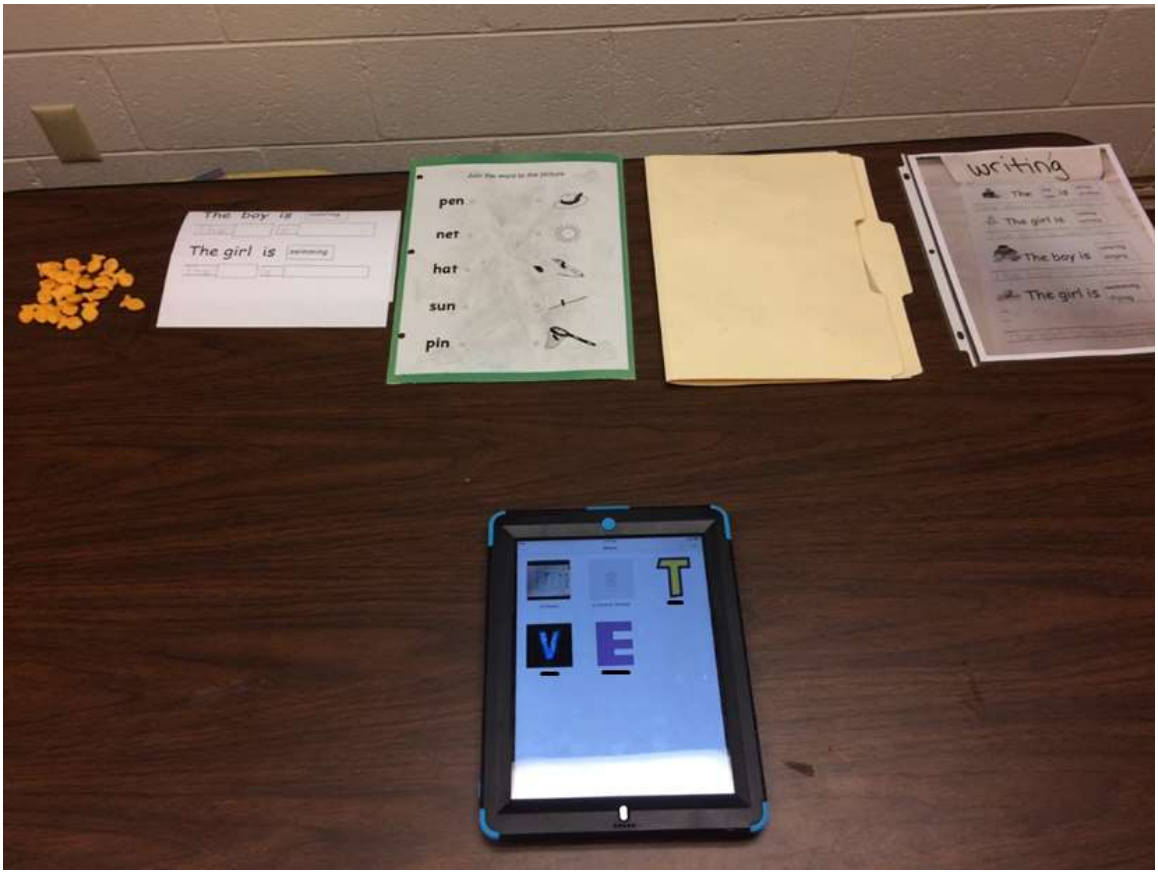
____ (d) materials for activities are within 10 feet of the child

____ (e) researcher reads the list of four activities aloud, then gives the instruction, “Do your work.”

____ (f) only verbal prompts are provided for each activity and transition.

APPENDIX F

IPAD VISUAL ACTIVITY SCHEDULE AND MATERIALS


The girl is
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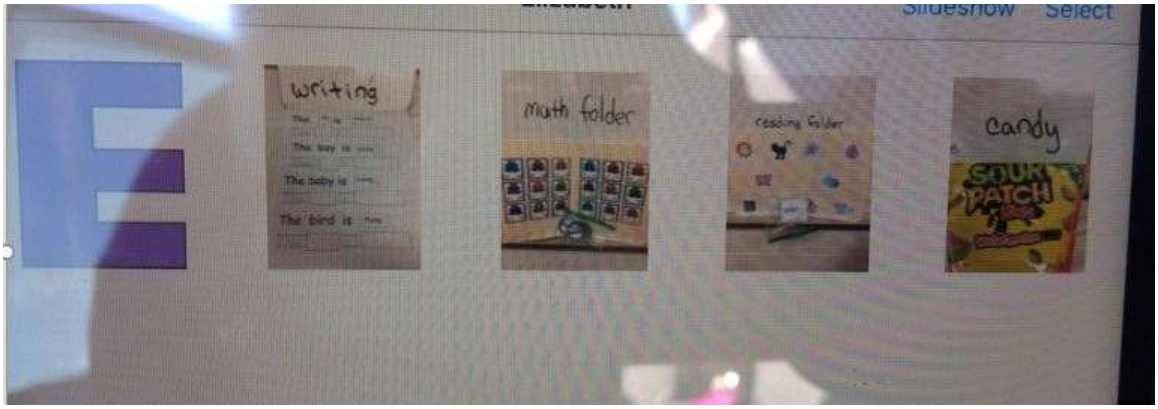
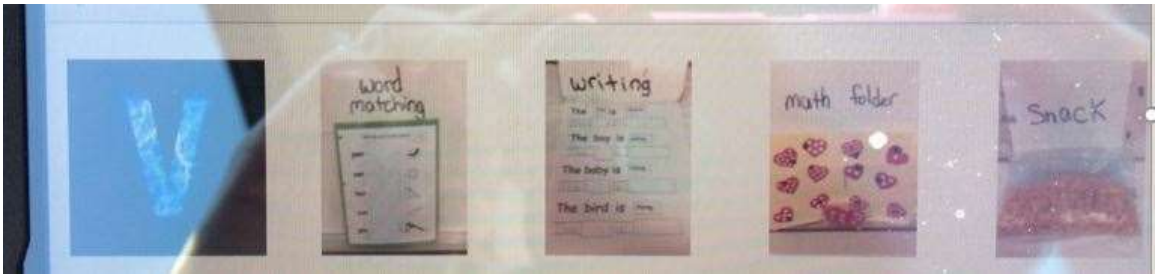
E

APPENDIX G

IPAD VISUAL ACTIVITY SCHEDULE - OVERVIEW





Students clicked on the letter of their name and swiped from one picture to the next.