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A Comparison of the Effects of Low- and High-Technology Activity Schedules on Task Engagement of Young Children with Developmental Disabilities

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A COMPARISON OF THE EFFECTS OF LOW- AND HIGH-TECHNOLOGY ACTIVITY SCHEDULES ON TASK ENGAGEMENT OF YOUNG CHILDREN WITH DEVELOPMENTAL DISABILITIES

By

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A DISSERTATION

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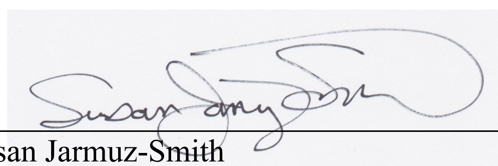

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Susan Jarmuz-Smith Date

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An Abstract of the Dissertation Presented

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Individuals with intellectual and developmental disabilities may have challenges with executive functioning skills (e.g., planning and organization). Research has shown that external supports, such as activity schedules, increase independence and task engagement. With the availability of mobile devices, activity schedules can be presented to individuals in a flexible and durable manner. Three elementary school students used a low-technology paper-based activity schedule (LT), a high-technology activity schedule (HT) on an iPad, and an ultra high-technology schedule with audio and video (UHT) on an iPad for the same routine. Results demonstrated increased on-task behavior with the use of an activity schedule over none. However, there were no significant differences in on-task behavior among paper-based and iPad-based schedules. Still, preference assessments demonstrated students favored the ultra-high-technology schedule. Implications of these findings and future research are discussed.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION & LITERATURE REVIEW

Many individuals carefully plan their daily activities, such as work-related tasks, health-related appointments, and school-related events, to ensure appointments are kept and tasks are completed on time. In addition to planning activities across the day, individuals also think about the specific steps needed to get to an appointment on time or complete a certain task. The success and broad use of organizational products such as Franklin Covey, Day Runner systems, and OmniFocus software demonstrate the importance of planning in everyday life.

For individuals with an autism spectrum disorder (ASD) (American Psychiatric Association, 2013), research has shown there exist broad difficulties in executive functioning, such as planning and organization, self-regulation, and task engagement (Corbett, Constantine, Hendren, Rocke, & Ozonoff, 2009; Happe, Booth, Charlton, & Hughes, 2006). These limitations can affect an individual's ability to independently plan and organize a task, self-regulate behaviors related to that task, and maintain engagement, which leads to greater support demands on educators, clinicians, and parents. Ruble and Scott (2002) suggested that interventions to address and support executive functioning deficits would include external structuring, such as providing a daily list of tasks or activities.

In human service fields, lists of daily activities and tasks are referred to collectively as *activity schedules*, with the action of planning and creating lists referred to as *activity scheduling*. An activity schedule can be thought of as any type of written, visual, or interactive plan that lists activities in a specified order with plans for transitioning from one activity to the next. In educational settings, activity schedules are utilized to increase task engagement for students with organization and planning difficulties (MacDuff, Krantz, & McClannahan, 1993) and often take the form of a three-ring binder containing pages with pictures of tasks to be completed (Wacker & Berg, 1983; Wacker, Berg, Berrie, & Swatta, 1985) or small, laminated pictures attached to a white board with Velcro. Once each task is complete, the page is turned and the next task is presented to the student, or the teacher uses a gestural prompt to point to the next task on the board. With the introduction of computers and mobile devices, activity schedules have appeared on computers (e.g., Microsoft PowerPoint) and mobile devices (e.g., iPads and Android platforms). Yet, research is limited on the effectiveness of translating activity schedules from traditional methods to computer-based, “higher-tech” implementations. The cost of higher-tech devices, such as an iPad, may not increase the effectiveness enough to warrant the outlay of the device’s cost. The goal of this research is to compare the effectiveness of paper-based and technology-based implementations of activity scheduling.

Literature Review

The Basics of Activity Scheduling

Activity scheduling has been used to support teaching, maintenance, and generalization of new skills in adults (Sowers, Rusch, Connis, & Cummings, 1980; Wacker & Berg, 1983; Wacker et al., 1985; Anderson, Sherman, Sheldon, & McAdam, 1997) and children (MacDuff et al., 1993; Waters, Lerman, Havonetz, 2009; Miguel, Yang, Finn, & Ahearn, 2009; Betz, Higbee, & Reagon, 2008; Krantz, MacDuff, & McClannahan, 1993) with a variety of abilities and disabilities. Research has shown that activity schedules can be used to support the acquisition of independent time management responding (Sowers et al. 1980); acquisition, generalization, and maintenance of complex chains of behavior (Wacker & Berg, 1983; Wacker et al., 1985; MacDuff et al., 1993; McClannahan, MacDuff, Krantz, 2002); increased social interactions (McClannahan & Krantz, 1999; Betz et al., 2008); increased engagement in activities (Krantz et al., 1993; Anderson et al., 1997; McClannahan et al., 2002); and greater independence (MacDuff et al., 1993; Anderson et al., 1997; McClannahn & Krantz, 1999; Rehfeldt, 2002; McClannahan et al., 2002).

In 1983, Wacker and Berg sought to evaluate the effects of activity scheduling on task completion by individuals with moderate to severe cognitive disabilities. The participants in the study were asked to build a black valve, a circuit board assembly, a double red valve, and complete a packaging activity. After training the participants on the use of a photographic activity schedule, the researchers used a multiple-baseline design to analyze the effects of the activity schedule on the percentage of steps completed correctly. When the participants used the activity schedule to complete the assigned tasks, they did so independently and without researcher support. Results showed that participants became proficient at completing the assigned tasks independently. The key implication of these findings on the current research study is that activity scheduling was found to positively affect task completion and independence.

In 1993, MacDuff et al. evaluated the effects of photographic activity schedules on on-task and on-schedule behavior. The participants, four boys with autism (ages 9, 9, 11, and 14), were trained on the use of photographic activity schedules containing pictures of leisure and homework activities. Using a multiple-baseline across participants design, data were collected in relation to on-task and on-schedule behavior during baseline, teaching, maintenance, and generalization conditions. In addition to the photographic activity schedule, vocal, gestural, and manual prompts were provided as needed during the training sessions, but not during maintenance and generalization sessions. Results showed significant increases in on-task and on-schedule behavior for all children when using the photographic activity schedule. On-task and on-schedule behavior improved from highly variable or near zero to mean on-task and on-schedule performances above 90%. Once again, the findings demonstrated that activity scheduling was an appropriate intervention for individuals with difficulties related to independence and task completion.

Activity Schedule Components

Beyond a simple listing of activities or tasks, activity scheduling can be supported with add-on components that may increase effectiveness. These add-on components fall roughly into five categories: choice, advance notice, collaborative activities, communication across school and home, and audio prompting/video modeling (Tustin, 1995; Dyer, Dunlap, & Winterling, 1990; Krantz & McClannahan, 1998; Betz et al., 2008; Krantz et al. 1997, Mechling, 2007).

Choice. Choice within the use of activity scheduling occurs when a student chooses his or her activities, sequence of activities, and/or reward. Research has shown that choice, in and of itself, can be a reinforcer (Fisher, Thompson, Piazza, Crosland, & Gotjen, 1997; Tiger, Hanley, & Hernandez, 2006) and hence it may be deduced that choice could be a potent component of successful activity schedules. Results of Dyer et al. (1990) found that choice was in fact reinforcing. Their study included three participants (ages 5, 11, and 11); one was diagnosed with developmental delay, another with pervasive developmental delay, and the third with severe mental retardation. The participants were provided with two conditions - choice and no-choice – for selection of an academic task and a reinforcer for completion of that task. The researchers measured the percentage of disruptive behavior during both conditions in addition to the count of correct responses. The study showed that choice conditions integrated into the activity schedule produced lower levels of problem behavior and had no negative effects on correct responding. The authors suggested that the, “opportunity to choose tasks as well as reinforcers may have been a reinforcer in itself” (p. 523). This is an important finding that supports the implementation of a choice of tasks and reinforcers in the implementation of activity scheduling.

Advance notice. Advance notice is the use of verbal (vocal or non-vocal) warnings that an activity is about to end. While it may seem common sense to provide a warning about an upcoming transition, research has been mixed as to the effectiveness of this intervention (Tustin, 1995; Wilder, Nicholson, & Allison, 2010).

In Tustin (1995), one adult (age 28) with autism experienced two conditions during task changes within a vocational setting: an immediate change and a two-minute warning of the upcoming change. The researcher measured the percentage of stereotypy during task changes and showed that stereotypy decreased with the two-minute warning. However, Wilder et al. (2010) found differing results. Three typically developing preschoolers (ages 4, 4, and 5) with a history of non-compliant behavior were provided with the conditions of no advance notice, advance notice (two-minute warning, one-minute warning before instruction) alone, and advance notice with physical guidance. The researchers found that advance notice alone did not increase compliance and hence was not an effective intervention. In Tustin (1995), the participant moved from one vocational task to another vocational task whereas in Wilder et al. (2010), the participants moved from a high-preference activity to a low-preference activity. The differences in tasks may have led to the differences in findings.

Despite the mixed results, advance notice may be a feature care providers desire in activity schedules to notify students of upcoming transitions. These advance notifications could be implemented automatically within a high-tech implementation through countdown timers and/or the ability of the user to see the upcoming activity. Regardless of application type, any high-tech implementation of advance notice should be analyzed for effectiveness.

Collaborative activities. Increased social interaction is often a goal for children with developmental disabilities and activity schedules have been used successfully to build social interactions into daily activities (McClannahan & Krantz, 1999). For example, Betz et al. (2008) found that joint schedules that incorporate high technology increased peer engagement. They taught three pairs of preschoolers (between ages 4 and 5) with diagnoses of autism to follow joint activity schedules that prompted the students to play a sequence of non-computer and computer games together. The researchers measured peer engagement across teaching, maintenance, resequencing, and generalization conditions. They found that the duration of peer engagement increased significantly while the need for prompting decreased to nearly zero. The importance of this finding is that the inclusion of joint activities within a high-technology implementation of activity scheduling may increase a student's social interactions, often a key goal for children with autism. These interactions could occur in the immediate physical area, within the school, and between school and home. With the infusion of high technology, joint activity scheduling within the context of social networking may provide significant social benefits. The strength of this potential warrants further research.

Communication across school and home. Ideally, activity scheduling would be supported and connected across school and home environments. It is well established that partnering with parents is a research-based component of student academic, social, and occupational success (Christenson, Rounds, & Gorney, 1992; Esler, Godber, & Christenson, 2008).

Krantz et al. (1993), taught the parents of three children with autism (ages 8, 7, and 6) to use graduated guidance to teach their children to follow visual activity schedules for home-based activities. The researchers measured social engagement, social initiation, and interfering behavior and found that social engagement and initiation increased while interfering behavior decreased when the children used the activity schedules at home. This study demonstrated the effectiveness of parents in teaching and sharing activity-scheduling behavior in the home environment. There are difficulties, however, inherent in maintaining communication across school and home and current practices, such as written logs, may not be enough to foster the home-school bridge. Activity scheduling and supporting home-school collaboration may benefit from advances in how information is shared between home and school and a solution to this dilemma may exist in the application of technology (Rehfeldt, Kinney, Root, & Stromer, 2004).

The mobility of high-tech tools may support the acquisition, maintenance, and generalization of schedule following across home, community, and school. The importance of home-school communication within the use of activity scheduling has not been widely analyzed, which categorizes this particular component as needing further research. Given the evidence-base supporting home-school collaboration, integrating communication into a high-tech implementation of activity scheduling should be strongly considered.

Audio and video prompting. Audio and video prompting are evidence-based components of activity scheduling (Mechling, 2007; Sigafoos et al., 2007). Mechling (2007) cites several research studies that demonstrated the introduction of an audio prompt (defined as pre-recorded antecedent vocal cues) increased independence and task completion in individuals with developmental disabilities. Mechling (2007) noted that effective features of audio prompting included the ability for the schedule users to replay prompts when needed and the ability to choose the voice recorded (e.g., the user's voice or an authoritative voice).

Sigafoos et al. (2007) evaluated the effectiveness of video prompting in the acquisition and maintenance of dishwashing behavior. The participants were three adults with developmental disabilities (ages 33, 27, and 28) who were provided with a short video clip (5 to 30 seconds each) as a prompt for each of ten individual steps in a task analysis for dishwashing. The researchers measured the percentage of steps in the task analysis that were completed correctly within a multiple baseline across participants design. They found there was a significant increase in steps completed correctly given the support of the video prompts.

While audio and video prompting have been successful, their implementation as add-ons to paper-based activity schedules may be cumbersome. High-tech implementations of activity schedules could offer a solution for adding audio and video prompting in a way that is directly integrated into the tech-based activity schedule itself.

From Paper-Based to Digital Schedules

Mechling (2007) reviewed over 40 studies related to assistive technologies that supported the independent completion of daily tasks by individuals with intellectual difficulties. She found that visual schedules presented on portable devices were more effective than visual schedules presented on cards; students had a higher level of engagement and correct responding with a high-technology version. In the acquisition of reading, Williams, Wright, Callaghan, and Coughlan (2002) found that reading skills for students with autism increased with the use of a high-technology intervention over the use of a paper-based intervention. They speculated that the increase in learning occurred because the students engaged longer using the computer implementation and rarely refused to cooperate in that condition. Stromer, Kimball, Kinney, and Taylor (2006) examined literature related to the combination of activity scheduling and computer technology (e.g., Microsoft PowerPoint) to discern if the combination of the two could provide more effective interventions for students with autism. They analyzed several studies that showed multimedia presentations of activity schedules, some with embedded video modeling, increased student training results for certain activities. Chan, Lambdin, Graham, Fragale, and Davis (2014) demonstrated that an iPad-based activity schedule increased completion of community-based tasks, such as grocery shopping.

The findings of Mechling (2007), Williams et al. (2002), Stromer et al. (2006), and Chan et al. (2014), demonstrate that high-technology implementations of activity scheduling warrant further analysis. Specifically, the characteristics of high-tech implementations, such as feature-rich portability, user-friendly differentiation, and extensibility (i.e., using the full capabilities of the platform) need additional study to determine if they can be generalized across students.

Portability. At its core, technology is defined as the use of tools to adapt to our natural environment (Bölte, Golan, Goodwin, & Zwaigenbaum, 2010). While our species has been using technology to adapt since the invention of fire, the most recent iteration of advancement has been the emergence of mobile computing. Since the introduction of intelligent mobile devices (as opposed to basic cell phones) two decades ago, development has continued with the current pinnacle of achievement being the tablet computer (e.g., Apple iPad, Microsoft Surface, Samsung Galaxy Tab). These devices are so ubiquitous that they have penetrated 75% of the US market and over 100% of the Asian market (i.e., users have more than one mobile device) (Head & Ziolkowski, 2012).

The increase in portability has meant that users could move from their desks to other environments and maintain access to important tasks as well as Internet access. Traxler (2010) stated, "when we say we can ignore desktop technologies but not mobile technologies we mean that desktop technologies operate in their own little world, mobile technologies operate in *the* world" (p. 3). What this means to the applied use of activity scheduling is that schedules can move with the student across settings, which is a potentially powerful application. It should be noted that many adult professionals carry their mobile phone (e.g., iPhone) with them at all times to access their organizational software (e.g., OmniFocus) and/or their calendar (e.g., iCal). Mobile computing may be able to offer this level of usage and access to students with organizational and engagement difficulties. Wacker and Berg (1983) demonstrated that dependence on activity schedules occurred with their participants; the ubiquitous nature and mobility of high-tech devices might make this a moot concern.

Differentiation and Extensibility. When mobile devices began to move into the educational market, software developers started to ask people about their preferences. Putnam and Chong (2008) found, in a sample recruited through online listservs related to Autism in the Western United States and consisting of parents (N = 81), special education teachers (N = 21), and adults with ASD (N = 12), that survey respondents wanted software that supports social functioning (collaborative activities), activity scheduling, and data collection. Traxler (2010) argued that the definitive success of mobile computing would be the ability to differentiate hardware and software for each student's need and comfort. Bölte et al. (2010) suggested software interfaces for use with individuals with autism that have limited distracting stimuli and are presented using design principles that group buttons and text in a simple and functional layout. Interestingly, Head and Ziolkowski (2012) found that educational users gave more weight to the usability of an application rather than its capabilities. Clarke, Austin, and Craike (2014) surveyed parents (N = 90) and educators who work with children with autism (N = 31) about their attitudes and use of iPads in educational settings. What they found was that even though parents and professionals desired to use iPads in their work with children, they did not. Reasons provided included technology-related anxiety and lack of an evidence-base for iPad effectiveness.

Finally, the use of technology in the implementation of activity scheduling in educational settings would ideally use the broad extensibility of the technology platform. Extensibility refers to using the full capabilities of a hardware and software system. With respect to an activity schedule, this means re-imagining the implementation of a schedule so that it is not a mere copy of a paper and pencil schedule on an expensive piece of equipment but uses the bells and whistles technology provides. Murray and Olcese (2011) conducted an analysis of 317 applications released under the category of "Educational" on Apple's AppStore over a period of two months. What they found was a collection of applications created for the iPad platform that were simply high-tech copies of worksheets and other paper and pencil tasks with limited extension into the iPad's high-tech capabilities and also out of sync with modern theories of teaching and learning.

High-tech solutions that use the full extensibility of their platforms might include such features as image capture, video modeling, social networking, timers, etc. Additionally, the iPad uses gyroscopes, which are small devices that measure how the device moves side-to-side and up-and-down. The use of gyroscopes can be seen in applications that require rotation during use, such as MultiPonk or Tilt Ball. This feature allows users with difficulties swiping or tapping screens to move the device to signal an activity is complete. Another consideration in addition to video modeling is tactile prompting (i.e., vibration) and pre-recorded audio prompting. The features and capabilities that high-technology devices (e.g., iPad, Windows Surface, Samsung Galaxy Tab) provide are abundant and increase each time a new generation of the device or operating system is released.

Extensibility becomes a double-edged sword, however. As application designers consider the implementation of differing features that would utilize new and expanding capabilities, care must be taken to ensure that new ultra-high-technology components are actually effective at helping students reach their goals. New devices, new capabilities, and new technologies become novel and exciting ways to implement interventions with students. But, just adding “bells and whistles” because they are possible, does not make an application better. The onus is on members of an Individual Education Program (IEP) team, especially those with expertise in research methods and evidence-based practiced (e.g., school psychologists), to confirm that those novel interventions do no harm and actually benefit students.

Current Options. A review of existing high-technology implementations of activity scheduling revealed four examples. Rehfeldt et al. (2004) utilized Microsoft PowerPoint to setup activity schedules on computers within classrooms. They did not evaluate the effectiveness of this medium but rather described the capabilities of this software and demonstrated the implementation. Hayes et al. (2010) described three system prototypes for activity scheduling that included a large display, a mobile device, and a personal recording device. The system of support did not include direct research on the effectiveness of the activity scheduling implementation but did capture focus group data about the prototypes. They found that teachers desired flexibility, customization per student, communication across settings and people (e.g., child, teacher, caregiver, parent), facilitation of goal setting, and data collection.

Cramer, Hirano, Tentori, Yenganyan, and Hayes (2011) implemented a class-wide system of scheduling that included a visual schedule, a system of choice, and a system of reinforcement. The system provided each student with a mobile device and included one large classroom display for public posting of individual student progress. The researchers measured the frequency of adult prompting before and after deployment of the system. The researchers found that the high-tech visual scheduling system significantly reduced teacher prompting.

Mintz (2013) implemented a mobile application for social skills training and practice and captured user information about factors mediating the use of applications on mobile technologies. He found that the following factors affected student use of the device: device attachment (i.e., student's attitude toward the device), portability, effective home-school communication, and self-awareness of why the student needed to use the device. King, Thomeczek, Voreis, and Scott (2014) observed the use of iPad applications in educational settings and found that appropriate use was variable and often not based on evidence, due to the lack of available studies. King et al. suggested future research into the effects of iPad applications on learning in comparison to traditional methods.

Available research suggests that there is a need for more inquiry about the interaction of mobile technology devices and behavior analytic interventions. Recently, the *Journal of Applied Behavior Analysis* published an article detailing the steps behavior analysts could take to program and implement their own iPhone application for collecting ABC data (Whiting & Dixon, 2012). While the use of this article may be limited to a handful of vigorously interested readers and limited in shelf life due to constantly changing technology, it demonstrated interest in the effects of human-computer interaction in the field of behavior analysis. Given the findings that activity scheduling is a successful intervention for individuals with autism and the increasing interest in using high-technology tools, the purpose of this research study is to evaluate the effectiveness of using high-technology activity schedules compared to a paper-based schedules.

Research Questions

Based upon the available research, activity schedules were categorized into the following: low-technology (LT), high-technology (HT), and ultra-high technology (UHT). For the purposes of this research, LT schedules were paper-based schedules whereas HT schedules were versions of the paper-based schedules presented on a mobile device. HT schedules simply mimicked the LT versions and went no further in utilizing the full capacity of the high-technology device. The UHT schedules utilized further capabilities of the device, such as audio and video prompting. The following research question was explored: which implementation of an activity schedule (LT, HT, UHT) in an educational setting demonstrated the greatest improvement of participants' on-task behavior?

It was hypothesized that the UHT activity schedule would demonstrate the greatest increase in on-task behavior. It is important to note that activity scheduling not only supports the acquisition of specific skills, as noted earlier, but also teaches the skill of following a schedule itself (Wacker & Berg, 1983). McClannahan et al. (2002) noted that, "people become such expert schedule followers that, given schedules, they achieve criterion or near-criterion performances on first attempts at new tasks" (p. 16). In this research, the application of three types of activity schedules was explored with skills already mastered by the participants as indicated by teacher report.

CHAPTER 2: METHOD

Participants

Three elementary-aged students with developmental or intellectual disabilities participated in this study. Kim[1] was a first-grade, 7-year-old boy diagnosed with a mild intellectual disability. He performed in the below average range on an intellectual assessment (Wechsler Preschool and Primary Scale of Intelligence, Fourth Edition; Full-scale Intelligence Quotient: 70 Standard Score) and on an adaptive measure (Vineland-II; Adaptive Behavior Composite: 65 Standard Score). According to the DSM-V, he met the criteria for a diagnosis of Intellectual Ability with Mild Severity (317). His schedule involved three tasks: complete a writing worksheet, read a book aloud, and complete a color by numbers worksheet.

James was a 6-year old, Kindergarten boy diagnosed with Autism Spectrum Disorder by an outside, medical specialty practice. His evaluation reported severe deficits in social communication, social interaction, and restrictive and repetitive behaviors (Social Responsive Scale, Second Edition [SRS-2]; exact scores not provided) and deficits in adaptive behavior (Adaptive Behavior Assessment System, Second Edition [ABAS-II]; General Adaptive Composite: 73 Standard Score). According to the DSM-V, the evaluator reported that James met the criteria for Autism Spectrum Disorder (299). His schedule consisted of: sitting in a chair, grasping a pencil, completing a math worksheet, turning the page of the booklet, and completing another math worksheet page.

Archer was a 6-year-old, Kindergarten boy diagnosed with Autism Spectrum

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[1] All names are pseudonyms.

Disorder by the same medical specialty practice. The evaluator reported moderate to severe deficits in social communication, social interaction, and restrictive and repetitive behaviors (SRS-2; exact scores not provided) and deficits in adaptive behavior (ABAS-II; General Adaptive Composite: 78 Standard Score). According to the DSM-V, the evaluator reported that Archer met the criteria for Autism Spectrum Disorder (299). He completed the same schedule as James: sit in a chair, grasp a pencil, complete a math worksheet, turn the page of the booklet, and complete another math worksheet page. Schedules were derived from IEP goals for each student.

Table 1 displays demographic data for the participants. All three participants were Caucasian males. One of the students was eligible for free or reduced cost lunch. All three demonstrated difficulties in completing known tasks independently. Exclusion criteria included students who had a history of self-injurious behavior (SIB) and those whose hearing, vision, or other impairments prevented the use of a tablet computer-based schedule system. All study methods wand procedures were reviewed and approved by the University Institutional Review Board (IRB).

Table 1

Demographic data for participants

Participant	Age (years)	Grade	Diagnosis	Gender	Race	SES Level*
Archer	6	K	Autism	Male	Caucasian	Middle
James	6	K	Autism	Male	Caucasian	Middle
Kim	7	1	Intellectual Disability	Male	Caucasian	Low

* SES: socio-economic status

Setting

Data collection occurred within a 30-foot by 20-foot room designed as a self-contained setting for students with developmental and intellectual disabilities in Kindergarten through second grade. Kim spent 60% of his day in the room, James spent

100%, and Archer spent 15%. The room contained four separate work areas: an open floor area for group work; a kitchen area with a table, refrigerator, and sink; a work area with a kidney table; and arrival/dismissal area with buckets for student folders and hooks for bags and outerwear.

The program was managed by one lead teacher and five educational technicians. The room contained from one to nine students at any moment in time; student schedules varied throughout and between days. The level of activity in the room was generally calm and quiet, due to high quality classroom management. However, one student who was not a subject in this study engaged in infrequent loud, yelling behavior. The lead teacher said that most students in her room had mostly habituated to the yelling; she reported that the yelling behavior did not distract the participants during data collection in any observable way.

The lead teacher had a master's degree in Special Education and had worked in that field since 1996. She reported using activity schedules as part of her daily work with students since she began teaching. The lead teacher's prior experience with research included the completion of her own thesis.

Independent Variables and Materials

An activity schedule was created and implemented to support each participant's specific routine. Separating out the schedule-following behavior from the task-oriented behavior allowed for greater analysis of the effects of the features of the activity schedule itself (Millard et al., 1993). For this study, known tasks were chosen by the students' teacher based on data collected prior to the start of this project; thus, each student's activity schedule was unique to his known tasks. An activity schedule that a participant could complete with greater than 60% independence was excluded. Each participant utilized three sets of materials, which defined the research conditions.

LT condition. The LT condition included a paper-based visual/textual activity schedule with tasks typed on paper, then laminated and Velcro-ed to a laminated white paper for use during the specific routine.

HT condition (*SR Basic v1.0*). The HT condition included a visual/textual activity schedule simulated on an iPad application, which was as close a replication as possible of the low-technology version.

UHT condition (*SR Pro v1.0*). This condition included a visual/textual schedule delivered on an iPad that used additional capabilities of the iPad, including audio and video prompts. Audio prompts consisted of pre-recorded vocal prompts that were paired with an activity picture. Video prompts were short video recordings (1-10 seconds) of the beginning of a task, such as turning a page, or picking up a pencil to write. Some video prompts contained audio and some did not.

Every effort was made to replicate the stimulus materials across the conditions with respect to size, color, shape, and content to limit any confounding variables. The iPad applications were written using Objective-C 2.0 within the Xcode Integrated Development Environment for iOS (versions of all software utilities changed throughout the development lifecycle: Xcode 4.x to 6.x, iOS 5.x to 8.x; Jarmuz-Smith, 2013-2015). Appendix A displays the differences among condition types (LT, HT, and UHT).

Each type of the independent variable (e.g., schedule condition) was provided to the participant directly after an adult vocal prompt (e.g., "Follow your schedule"). Appendix B provides an instructional protocol for the adult providing the intervention prompt and activity schedule. For the maintenance probe, only the initial vocal prompt of "Follow your schedule" was provided along with the needed materials.

Dependent Variables

Four measures were used to evaluate the effects of each condition for each participant: (a) on-task behavior, (b) vocal prompting, (c) gestural prompting, and (d) physical prompting. Vocal prompting consisted of the instruction, "Follow your schedule." Gestural prompting was pointing to the schedule task. Physical prompting involved hand over hand support for the task. In order to document whether a condition affected a student's on-task behavior for student-specific task demands, each student's on-task behavior was recorded using direct observation procedures. For this study, a participant was considered on-task if he was looking at the specified type of activity schedule, attending to the appropriate activity materials, engaged in vocal responses that were related to the task, manipulating the appropriate activity materials, or transitioning from one activity to the next. Adult prompting was counted for each vocal, gestural, and physical prompt required to keep or return the student to the task demands. On-task behavior was recorded using a 6-second interval recording procedure (see Appendix C). Timing for data collection began immediately after the initial prompt of "Follow your schedule." The teacher used a stopwatch attached to a clipboard for timing. The teacher waited five seconds between each vocal, gestural, or physical prompt. For example, after delivering the "Follow your schedule" prompt, the teacher would wait five seconds for the student to respond with on-task behavior. If the student did not respond with on-task behavior, she would repeat the vocal prompt. If the student continued to demonstrate off-task behavior, she would provide a gestural prompt after five seconds. Again, if the student did not respond with on-task behavior for another five seconds, then she would use a physical prompt. If the student did respond with on-task behavior during the next 6-second whole interval to any level of prompt, then on-task behavior was recorded and the teacher would return to the first level (vocal) of the prompt hierarchy at the next instance of off-task behavior. If the student demonstrated on-task behavior for a partial interval, she would repeat the same level of prompt provided previously.

In addition, the teacher completed the Treatment Evaluation Inventory-Short Form (TEI-SF; Kelley, Heffer, Gresham, & Elliott, 1989) for each student (Appendix D). The TEI-SF is a 11-item scale that evaluates the acceptability of the intervention. Internal consistency is high (*a* = .94 to .96) and construct validity is acceptable. Each item is a 5-point Likert scale, therefore scores can range from 11 to 55. A mid-range score of 30 would indicate moderate acceptance of the intervention. Last, forced-choice preference assessments comparing the LT, HT, and UHT conditions were performed with students at the conclusion of the study (Appendix E).

Procedures

Baseline data. Prior to beginning the intervention, each participant's on-task behavior for the target routine was observed using 6-second interval recording procedures. These data provided indicators of the students' pre-intervention levels of completion of key tasks expected in their school programs.

Intervention training. To be certain the subjects understood and were able to use all three types of activity schedules, the participants were trained on the use of activity scheduling with the low-tech, high-tech, and ultra-high-tech activity schedules. The lead teacher used modeling to demonstrate the use of the schedules and considered the training complete when the participant could use all schedules fluently (according to her judgment). The participants were trained after baseline sessions and before intervention sessions by the lead teacher of the classroom.

Kim had no previous training or knowledge of visual activity schedules, but was familiar with the use of an iPad. James had several years of experience with the use of activity schedules and some understanding of the use of an iPad. Archer had no previous training or knowledge of visual activity schedules and was not familiar with the use of an iPad.

Treatment integrity and interobserver agreement. To verify the schedules were implemented accurately for each condition, 51% of sessions were videotaped and reviewed for treatment integrity. A Treatment Integrity Observation Checklist was used to determine acceptable treatment limits (Appendix F). Treatment integrity was 100% for all sessions except one, which was removed from the dataset. Treatment integrity was defined as the teacher preparing needed data collection materials; setting up needed schedule and activity materials; providing the initial prompt; and using prompting according to the experimental procedure, described above, greater than or equal to 95% of the session. During the session that violated acceptability a trained, but inexperienced, paraprofessional misused the beginning instruction prompt, the prompt hierarchy, and timing. The session was stopped after approximately one minute and data collected were removed from the data set.

In addition, interobserver agreement (IOA) was calculated based on the video-taped sessions. The data codes from the researcher, obtained via video observation, and the teacher were compared to identify the number of intervals when both observers agreed and the number when they disagreed. IOA was calculated using the number of agreements divided by the number of agreements plus disagreements and multiplied by 100 to yield a percentage. The IOA was 98% for observed sessions.

Experimental Design

A multiple-baseline across participants with alternating treatments embedded in the treatment phase was employed to assess the effects of the LT, HT, and UHT conditions. The alternating treatments component of the design was chosen to assess the differences among the interventions while controlling for sequence effects. In alternating treatment designs, interaction effects between or among treatments can become a methodological concern (McGonigle, Rojahn, Dixon, & Strain, 1987). McGonigle et al. (1987) discussed several factors that affect the alternating treatments, including (a) the reversibility of the behavior, (b) carryover between treatments, (c) the discriminative stimuli between interventions, (d) the intercomponent interval (ICI), and (e) potentially unequal extraneous conditions.

Nonetheless, the positive aspects of using an alternating treatments design for this research included the differing discriminative stimuli (paper or device) for the conditions, the potentially long ICI being greater than 1 hour between sessions, and the use of the final best treatment condition to assess that condition in isolation (Cooper, Heron, & Heward, 2007). However, factors that may have negatively affected the data collected through this research design include the durability of activity schedule behavior over time and the potential for unequal extraneous environmental variables due to the long-duration ICI. To minimize carryover effects, a Latin Square formula was used to counterbalance the interventions within the alternative treatments phase (see Appendix G).

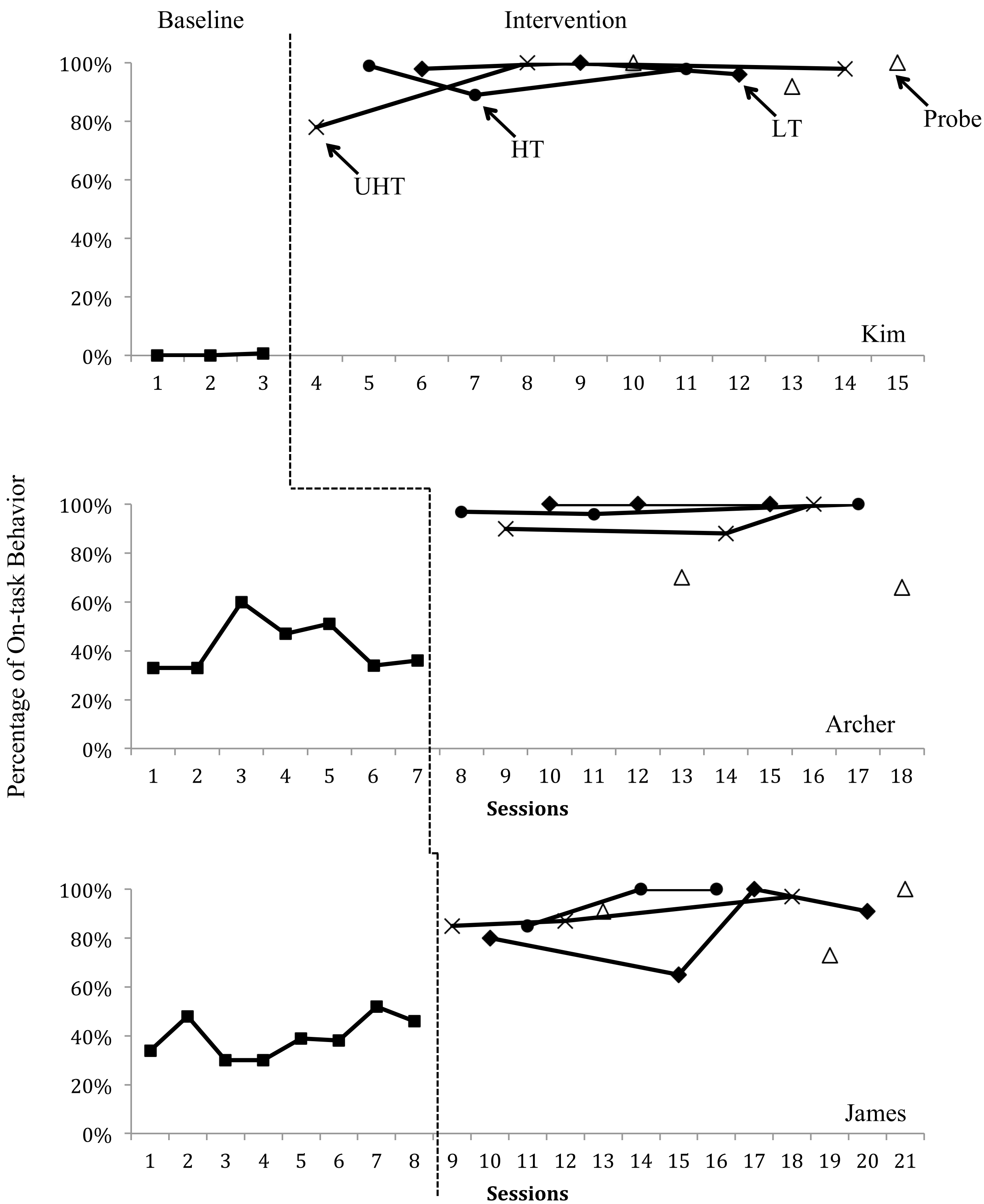
CHAPTER 3: RESULTS

On-Task Behavior

Figure 1 shows levels of on-task behavior for the three participants across all conditions. Kim had used a similar paper-based visual schedule with no success in the past, hence the lead teacher and researcher decided to continue this process for baseline. Kim's paper-based schedule consisted of Mayer-Johnson images Velcro-ed to a white, laminated piece of paper. As shown, in Figure 1, Kim did not use his schedule at all during baseline. Archer and James displayed variability in responding during baseline, although they did not use a visual schedule. The routine of tasks for Archer and James had not been used in a paper-based schedule in the past and so the lead teacher and researcher decided to continue this in baseline.

With each application of a visual schedule, on-task behavior immediately increased for all boys. Mean on-task behavior was 95% for Kim, 97% for Archer, and 89% for James across all schedule types. Mean on-task behavior during maintenance probes was 97% for Kim, 68% for Archer, and 87% for James. During session 15, James demonstrated low on-task behavior that was an outlier when compared to his overall performance. James had grown very reliant on his daily schedule that culminated in "go home." During that session, the lead teacher gave James the short paper activity schedule, which caused James to mand for his day-long schedule and his visual of "go home." It is possible that stimulus-stimulus pairing had occurred between the paper-based schedules. It took several vocal and gestural prompts to redirect him to the task. Table 2 demonstrates the mean on-task behavior for each participant and each type of schedule. Kim and Archer demonstrated the highest mean on-task behavior for the paper-based

Figure 1. *Percentage of On-Task Behavior*



schedule. James demonstrated the highest on-task behavior for the high-tech schedule. Across all participants, responding in the UHT condition was slightly lower than the HT condition.

Table 2

Mean On-Task Behavior per Participant per Schedule

Participant	LT	HT	UHT
Archer	100%	98%	93%
James	84%	95%	90%
Kim	98%	95%	92%

Each participant's activity schedule was provided, and data were collected, between one to three times per day. The lead teacher attempted to provide the schedule so that it was embedded naturally within each participant's daily routine. In general, the schedule was presented once in the early morning, once mid-morning, and once in the afternoon. Any deviation from this schedule was due to occupational and/or physical therapy sessions, illness, or other activities (e.g. Dr's appts.) managed by parents. When schedules were completed, Kim would move to a preferred activity; James and Archer varied between a preferred activity and the next educational task in their daily routine.

Adult Prompting

During baseline, interventions, and probes for maintenance, vocal, gestural, and physical prompts were recorded. Figure 2 shows the levels of prompting needed across all conditions. Vocal prompts consisted of statements such as, "follow your schedule." Gestural prompts consisted of pointing to the schedule. Physical prompts involved hand-over-hand guidance to complete or begin the task in the activity schedule. In baseline, Kim required vocal and gestural prompting. This decreased significantly across all conditions during intervention. Archer and James required prompting during baseline but still required limited prompting during intervention.

Figure 2. *Percentage of Prompting During Routine*

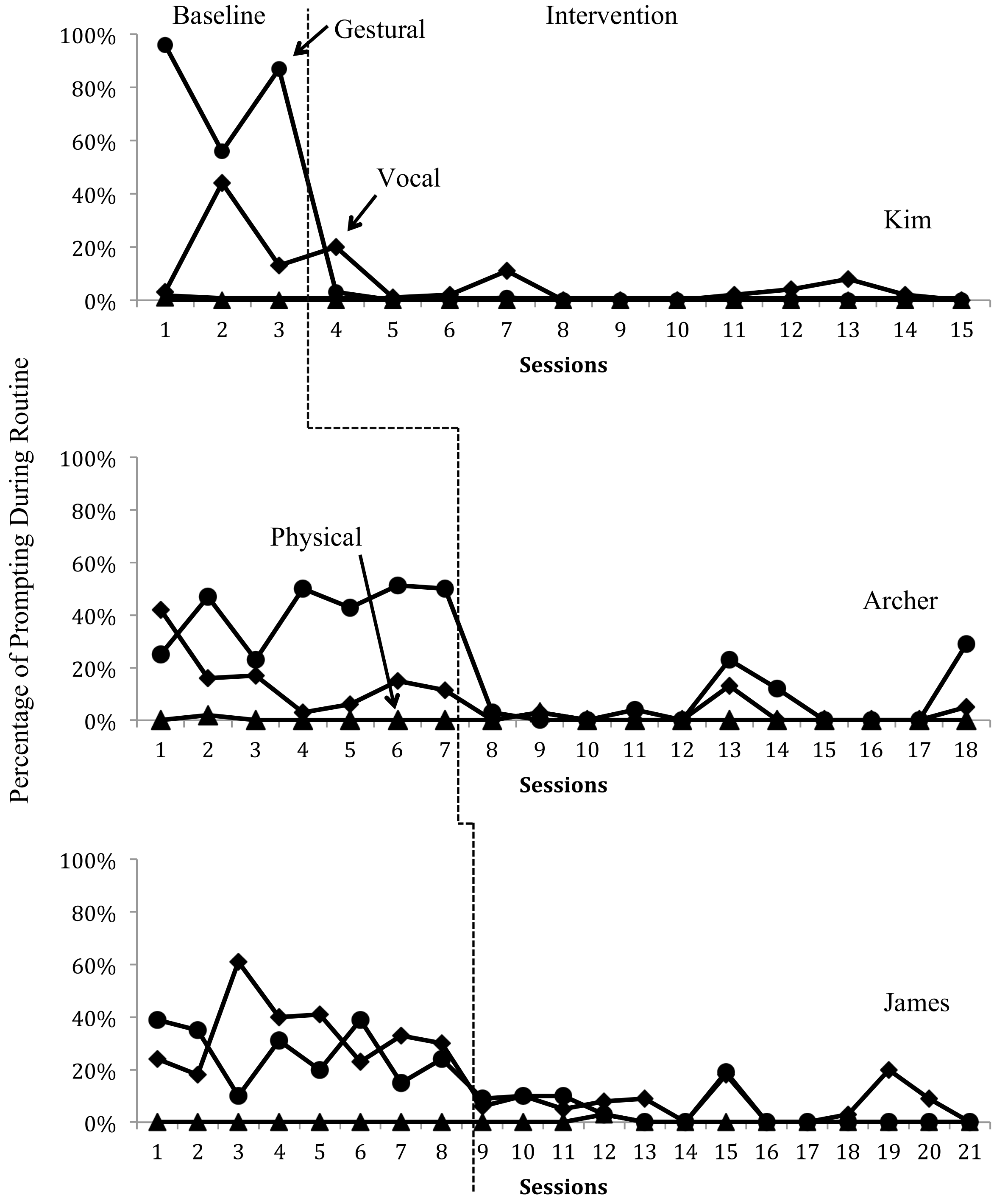


Table 3 shows the mean prompting required for each participant under each condition. Kim and Archer, who demonstrated the highest on-task behavior in the LT schedule, required the least amount of prompts with this type of schedule. James, who demonstrated the highest on-task behavior in the HT condition also demonstrated the lowest need for prompting in this condition. This makes sense mathematically since on-task behavior and prompting were considered mutually exclusive during data collection and only one or the other could be recorded.

Table 3

Mean Prompting Type Required Under Each Condition

Participant	LT-V	LT-G	LT-P	HT-V	HT-G	HT-P	UHT-V	UHT-G	UHT-P
Archer	0%	0%	0%	2%	0%	0%	4%	1%	1%
James	9%	7%	0%	2%	3%	0%	6%	4%	1%
Kim	2%	0%	0%	5%	0%	0%	7%	1%	0%

Student Preference Assessment

A forced-choice preference assessment comparing the LT, HT, and UHT conditions was performed with students at the conclusion of the study. Students were provided six opportunities to choose between two types of schedules. Each schedule was offered multiple times and balanced across left and right hands. Appendix E contains the form used to provide instructions to the teacher and record student responses. All participants demonstrated preference for the UHT condition (the iPad with audio and video prompting). No participants chose the paper-based schedule as preferred. Table 4 shows the results of the preference assessment.

Table 4

Schedule Preference Assessment

Participant	LT	HT	UHT
Archer	0%	50%	50%
James	0%	33%	67%
Kim	0%	33%	67%

Treatment Evaluation Inventory

The teacher who collected data for this study completed a Treatment Evaluation Inventory (TEI-SF) for each participant. She reported that Archer's focus was greatly improved, that he expressed interest in the treatment, was able to use what he learned, and that she understood Archer's needs better after the intervention. Her overall score for Archer on the TEI-SF was 46, which indicates high acceptability of the intervention. She also provided qualitative data in the form of a narrative summary.

Kim's teacher stated that since the schedule intervention, he behaved more appropriately, her relationship with him was stronger, and she observed a change in his skills. Her rating on the TEI-SF was a 49, which indicates high acceptability of the intervention. Kim's schedule involved writing a sentence about his day and reading a book out loud. In her narrative, the teacher noted that before this project she was seeing, "great resistance to transitioning to writing activities, reading, and coloring." Before the project, she was using a very broad visual schedule that did not break down complex chains of tasks into small units. She reported:

> I placed all of these [writing, reading, coloring] into the schedule with the activities at a level which he can do. He just [didn't] want to do them. I have seen a complete turn-around from him with the use of all schedules. He became so used to me using a schedule that during the [maintenance]

> probes (no schedule) he would pick on me and say I forget to get it but he would remember the sequence. I saw an improvement in his ability to read from the book we were using. This book has been part of his program for months and he showed more focus and made more connections with sight words. His fluency as he read also improved….By actions, comments and preference assessment he liked the use of the iPad schedules best. He liked the SR Pro most. If I placed the low tech schedule in front of him he would ask for the iPad.

Anecdotally, Kim's guardian mentioned that he noticed significant improvement in his reading at home.

Archer's teacher reported that he can be, "highly distractible" and observed that he was distracted by the video prompts on the UHT schedule. She also noted that he felt the need to, "match his actions exactly to the video." However, she also reported that he has had no prior, early intervention. He did not know how to use a visual schedule and go from picture to picture. She did observe an increase in his ability to use visual schedules and she planned to explore their use with him further.

For James, the teacher's overall score on the TEI-SF was a 47, which indicates high acceptability of the intervention. She reported that James was able to use the routine he learned, she observed a significant change in his skills, and she can use what she learned from the intervention. In the narrative, she reported that James relies heavily on paper-based schedules to get through the day. She did not see that he preferred one type of schedule but anecdotally reported that when he used the HT or UHT schedule he appeared to transition to and from his routines, "better/faster than with the low tech."

CHAPTER 4: DISCUSSION

Experimental data indicated that the three participants increased independence with the use of an activity schedule. Probes for maintenance during the intervention phase, and after, demonstrated durable changes in levels of independence. In addition to increased on-task behavior, vocal, gestural, and physical prompts decreased.

An interesting, and counterintuitive, finding in this study was that the increase in independence did not significantly differ among a paper-based schedule, a schedule on an iPad that mimicked the paper-based schedule, and a schedule on an iPad that included audio and video prompting. In fact, two participants' independence increased most with the paper-based schedule and one participant's on-task behavior increased most with the iPad-simulation of the paper-based schedule. However, students demonstrated preference for the UHT schedule and none preferred the LT schedule. In summary, the original hypothesis that the UHT schedule would demonstrate the greatest increase in on-task behavior was not supported by the data collected in this experiment.

Nonetheless, the present study extends previous investigations by comparing three differing types of activity schedules. Recent studies that incorporated technology into activity scheduling either utilized a class-wide system (Cramer et al., 2011), performed surveys of what teachers would like on a technology-based activity scheduling system (Putnam & Chong, 2008), or used only a picture-based schedule on an iPad (Chan et al., 2014). Previous research using iPad technology for reading demonstrated positive effects with the introduction of iPads (Williams et al., 2002). However, the results of the current investigation raise questions about the outlay of fiscal resources on technology-based interventions, such as iPads, that may not have an evidence-base supporting their effectiveness above and beyond lower cost options, such as paper-based schedules. It is possible that the return on investment does not exist. In this regard, the results suggest that it was the schedule itself, and not the format, that led to the outcomes.

There are possible explanations for the lack of differentiation in independence among the schedules. First, the routines used in this research consisted of known tasks. The schedules were simply used to prompt steps in a behavioral chain. It is possible that a better application of the UHT condition (SR Pro)'s audio and video prompting could be used to teach the actual tasks within each student's routine. Video modeling has been shown to be effective at teaching novel tasks (Mechling, 2007; Sigafoos et al., 2007). The UHT version could potentially be provided to a student for the acquisition of a new schedule of unknown tasks.

Second, the students each had three opportunities to work with in response to each condition. It is possible that the novelty of the iPad itself (HT) or the the audio/video prompting (UHT) presented a distractor. According to teacher report, this was possible. It could be that with more frequent use, the students would habituate to the iPad and instead focus on the schedule itself. Nonetheless, even if the presence of the iPad in the HT and UHT conditions was novel, the fact that the use of all three types of activity schedule resulted in such similar outcomes indicates that it was the *schedule* and not the device that really mattered.

It is important to note that while the data collected indicated the paper-based schedule supported the most on-task behavior, the students preferred the iPad-based schedules instead. As our society has become more technologically advanced, it is possible that mobile devices have become more acceptable than paper-based schedules or daily routines on a clipboard. While the participants in this study were in elementary school, it is logical to surmise that late elementary, middle, and high school students would prefer to carry around a technology-based schedule for social conformity. This would account for the universal preference for the iPad-based schedules over the paper ones. That, in and of itself, may be a motivator for students to use some type of activity schedule and set the stage for increased on-task behavior.

Limitations

Although this study's findings suggest promising results for the use of any type of activity schedule, there are limitations. Data were gathered by a classroom teacher in an applied setting, which was a classroom of students with intellectual and developmental disabilities. While this type of data collection contributes to the external validity of the findings, it diminishes the internal validity due to environmental threats such as distractors, urgent issues, and limited resources for data collection. It is possible that the obtained results were influenced by the specific setting.

Additionally, data were collected for a limited and specific period of time that may have confounded the results. As stated earlier, students preferred the technology-based scheduled but demonstrated lower on-task behaviors in these conditions likely due to the novelty of the iPad. A longer intervention with alternating phases of all conditions may have allowed for habituation to the iPad and differentiated responding across conditions.

Future Research

This investigation would benefit from systematic and/or conceptual replication. Other investigations would benefit from an examination of the responding of older students because students at the secondary level might be more sensitive to the social implications of various activity schedules. At the same time, they might be better able to utilize and benefit from the enhancements of more advanced technology applications. In addition, it would be interesting to apply schedule types similar to those used in this study to a chain of novel tasks. It may be that the use of an iPad-based schedule with video prompting and modeling could increase independence in new tasks.

Last, a longer timeline for intervention might habituate participants to the higher-technology schedules and demonstrate differential responding among them. If this finding occurs, then a component analysis of the differing features of the ultra-high-technology schedule (e.g., real visual prompting, audio prompting, video prompting) would be warranted.

CHAPTER 5: SUMMARY

Individuals with intellectual and developmental disabilities often have challenges with executive functioning skills (e.g., planning and organization). Research has shown that external supports, such as activity schedules, increase independence. With the current availability of mobile devices, activity schedules can be presented to individuals in a flexible, durable, and socially acceptable manner. Three elementary school students used a low technology paper-based activity schedule (LT), a high-technology iPad-based activity schedule (HT), and an ultra high-technology iPad-based activity schedule (UHT) for the same routine. Results demonstrated increased on-task behavior with the use of any of the schedules over none. However, there were no significant differences in on-task behavior among paper-based and iPad-based schedules. Also, there were no significant differences in adult prompting between the paper-based and iPad-based schedules.

Yet, preference assessments demonstrated students preferred the ultra high-technology schedule. This preference could have been due to the novelty of the higher-technology schedule as well as the social validity of using a computer-based schedule. It is notable that more adult prompting was needed to keep the students on-task and away from exploring the uniqueness of the iPad in the HT and UHT conditions. A longer intervention timeline might lead to more precise results by fostering habituation and possible differentiation among the schedule types. Teacher report found that, despite indifferent on-task responding by the participants, when using any of the three types of schedules, students transitioned to and from their academic routines more easily when using any of the three schedules, and their overall learning appeared greater than usual.

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Appendix A. *Differences among independent variable conditions.*

	Paper-based (LT)	**SR Basic (HT)**	**SR Pro (UHT)**
Visual prompts	✓	✓	✓
Textual prompts	✓	✓	✓
Auditory prompts			✓
Video prompts			✓
iPad platform		✓	✓

Appendix B. *Instructional protocol for application of the independent variable.*

Step	**Description**	**Completion Indicator**
Preparation for task	1. Prepare materials needed to complete the task. 2. Prepare the needed version of the activity schedule.	Materials and schedule are available and in place for task completion.
Step 1: Provide vocal prompt to student	1. Say, "Follow your schedule." (This vocal prompt is not included in the data collection.)	Vocal prompt provided – visual confirmation that student heard the prompt.
Step 2: Provide activity schedule to student	2. Place activity schedule in front of student in a way that is visible to the student but does not block access to needed materials.	Schedule is in front of student.
Step 3: Collect data	3. Use the data collection sheet to gather on-task and prompting data during the duration of the task.	Task is complete.

O = On-task
G = Gestural prompt needed
V = Vocal prompt needed
P = Physical prompt needed

Appendix C. *Data collection instrument.*

Participant Pseudonym: ____ Task: ____

Experimental Condition: (circle one) LT HT UHT

	0:00		**2:00**		**4:00**		**6:00**		**8:00**		**10:00**		**12:00**
:00-:05	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:06-:11	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:12-:17	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:18-:23	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:24-:29	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:30-:35	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:36-:41	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:42-:47	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:48-:53	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:54-:59	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
	1:00		**3:00**		**5:00**		**7:00**		**9:00**		**11:00**		**13:00**
:00-:05	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:06-:11	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:12-:17	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:18-:23	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:24-:29	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:30-:35	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:36-:41	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:42-:47	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:48-:53	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P
:54-:59	O V G P		O V G P		O V G P		O V G P		O V G P		O V G P		O V G P

Appendix D. *Treatment Evaluation Inventory*.

Treatment Evaluation Inventory – Short Form

Question	Strongly disagree	Disagre e	Neutral	Agree	Strongly Agree
1. Child now behaves more appropriately.	1	2	3	4	5
2. Child's behavior has improved.	1	2	3	4	5
3. Child's relationship with his or her teacher has improved.	1	2	3	4	5
4. Child learned about controlling his or her behavior	1	2	3	4	5
5. Child can use and apply what he or she has learned.	1	2	3	4	5
6. You've seen a change in the child's skills.	1	2	3	4	5
7. You rate the intervention highly.	1	2	3	4	5
8. Child has expressed interest in the treatment.	1	2	3	4	5
9. Child can use what he or she has learned.	1	2	3	4	5
10. Child gained new information about his or her behavior.	1	2	3	4	5
11. Teacher understands the child better.	1	2	3	4	5

Modified version of Newton & Sturmey (2004)'s Treatment Evaluation Intervention – Short Form

Appendix E. *Forced-Choice Preference Assessment*.

Forced-Choice Preference Assessment Form

Date: ____________________
Student Name: ____
Teacher: ____

Instructions:
1. Present both schedules simultaneously. Place the first one on your left, the second on your right. When using the iPad, demonstrate the schedule so the student can determine if it is a HT or UHT.
2. If the student does not select one, say, "Which one would you like to use more?"
3. Record as a selection any touch to an item. Circle the selected items.
4. Block any attempts to touch both items simultaneously.
5. If no response is made in 10 seconds, record "NR" and move to the next trial.
6. Be sure the student knows what the options are before selection.

TRIAL	LEFT	RIGHT
1	**LT**	**HT**
2	**UHT**	**LT**
3	**LT**	**UHT**
4	**HT**	**UHT**
5	**HT**	**LT**
6	**UHT**	**LT**

SUMMARY
LT SELECTED _____ OUT OF 6 OR _____% OF OPPORTUNITIES
UT SELECTED _____ OUT OF 6 OR _____% OF OPPORTUNITIES
UHT SELECTED _____ OUT OF 6 OR _____% OF OPPORTUNITIES

Appendix F. *Treatment Integrity Checklist*

Item	**Indicator**
Teacher prepared needed data collection materials before session began (e.g., clip board, timer, pencil, data collection sheet).	Y or N
Teacher setup materials according to the instructional protocol (e.g., schedule available, materials available).	Y or N
Teacher provided the initial prompt, “Follow your schedule.”	Y or N
Teacher provided the prompts as required by the experimental protocol. Prompts were provided correctly a minimum of 95% of the session.	Y or N

Appendix G. *Alternating treatments counterbalancing*.

A Latin Square was applied to counterbalance treatments across participants:

Latin Square:

$$\begin{bmatrix} A & B & C & A & C & B & C & B & A \\ B & C & A & B & A & C & A & C & B \\ C & A & B & C & B & A & B & A & C \end{bmatrix}$$ Conditions: A = LT; B = HT; C = UHT

time →

Participant 1:

- Counterbalanced conditions: A-B-C-A-C-B-C-B-A
- Application: LT-HT-UHT-LT-UHT-HT-UHT-HT-LT

Participant 2:

- Counterbalanced conditions: B-C-A-B-A-C-A-C-B
- Application: HT-UHT-LT-HT-LT-UHT-LT-UHT-HT

Participant 3:

- Counterbalanced conditions: C-A-B-C-B-A-B-A-C
- Application: UHT-LT-HT-UHT-HT-LT-HT-LT-UHT

Biography of the Author

Susan Jarmuz-Smith was born in Nashua, New Hampshire, and received her high school diploma in Hudson, New Hampshire. She completed the first three years of her engineering degree at Case Western Reserve University in Cleveland, Ohio (in addition to meeting her future husband Nate). Due to a job transfer, she moved to Portland, Maine where she finished her B.S. in Electrical Engineering with a concentration in Computer Engineering from the University of Southern Maine in 2001. From 1995 to 2005, she worked as an engineer at various companies in the technology industry. Switching gears for family reasons, she attended the University of Southern Maine and earned her M.S. in Educational Psychology with a concentration in Applied Behavioral Analysis in 2010. She is a Board Certified Behavior Analyst. During her doctoral studies, she worked in several public schools and was a Lecturer at the University of New England in the Department of Psychology and at the University of Southern Maine in the School of Education and Human Development. She has won the President's Award from the National Association of School Psychologists and the Irwin Hyman and Nadine Lambert Award from the American Academy of School Psychology. She is a candidate for the Psy.D. degree in School Psychology from the University of Southern Maine in May, 2015.