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iPads for Students with ASD: Comparing Delivery Modes for Visual Activity Schedules

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IPADS FOR STUDENTS WITH ASD: COMPARING DELIVERY MODES FOR VISUAL ACTIVITY SCHEDULES

by

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ABSTRACT

Visual Activity Schedules (VAS) are tools that present an abstract concept, such as time, in a more concrete and manageable form. VAS allow students to anticipate upcoming events and activities, develop an understanding of time, and facilitate the ability to predict change. Prior investigations have used VAS to increase on-task behavior while enhancing the student's ability to independently make transitions from one activity to another and are particularly appropriate as they capitalize on the visual strengths exhibited by many students with autism. Mobile devices such as the iPad are becoming a tool for teaching students with disabilities, and research is currently underway to determine the effectiveness of specific applications on student performance.

This research examined the impact of VAS delivered via the iPad, compared to a paper-based VAS, on the percentage of on-task behavior and median transition time for students with autism spectrum disorder (ASD) during academic center activities in an inclusive classroom setting. An alternating-treatment, single-subject research design was used to determine whether a divergence exists between the paper-based VAS and the iPad VAS. This study included three student participants who (a) had a diagnosis of ASD as stated on the Individualized Education Plan (IEP), (b) were in grade level K-1, (c) received instruction through Language Arts activity centers taught within one classroom, and (d) had difficulty with independent on-task behavior as reported by the participant's teacher.

Visual analysis of the data for on-task behavior revealed mixed results. Student 1 had a divergence between on-task behavior, with the paper-based VAS being a superior treatment condition to the iPad VAS 80% of the time. Student 2 also had a divergence between percentage of on-task behavior, with the iPad VAS being a superior treatment condition to the paper-based VAS 80% of the time. Student 3 had no clear divergence in percentage of on-task behavior between the iPad VAS and the paper-based VAS. All three participants had highly variable baseline and intervention data for transition time with a level stability range of 20% to 60%. Student 1 and Student 3 had no clear difference in transition time when comparing the paper-based VAS to the iPad VAS. Student 2 had a divergence in transition time data between the iPad VAS and the paper-based VAS, with the paper-based VAS being a superior treatment condition 90% of the time.

It was the support, love, and guidance provided by my mother

that made it possible for me to reach all of my goals and

dreams. Therefore, it is with great honor that I dedicate

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LIST OF ACRONYMS

ASD	Autism Spectrum Disorder
EBP	Evidence Based Practice
ESEA	Elementary and Secondary Education Act
FAIR	Florida Assessments for Instruction in Reading
IDEA	Individuals with Disabilities Education Act
IDEIA	Individuals with Disabilities Education and Improvement Act
IEP	Individualized Education Plan
IOA	Inter-observer Agreement
IRP-15	Intervention Rating Profile-15
LRE	Least Restrictive Environment
NCLB	No Child Left Behind
OHI	Other Health Impairment
PDA	Personal Digital Assistant
PND	Percentage of Non-Overlapping Data
RRBs	Restrictive and Repetitive Behavior, Interests, and Activities
SPL	Speech and Language Impairment
UDL	Universal Design for Learning
VAS	Visual Activity Schedule

CHAPTER ONE: INTRODUCTION

Background

The increasing prevalence rates of children reported to have a diagnosis of autism spectrum disorder is of concern to both educators and policy makers. This increase in autism prevalence rates is a continued trend with estimates from the 1970s and 1980s of four in 10,000 children reported to have a diagnosis of autism spectrum disorder (ASD) (Nygren et al., 2012), one in 150 children reported in 2007 (CDC, 2007), one in 110 children in 2009 (CDC, 2009), one in 88 reported in 2012 (CDC, 2012), and one in 68 reported in 2014 (CDC, 2014). Autism is a developmental disability that is characterized by symptoms including (a) social impairments, (b) repetitive behavior or obsessive interests, and (c) communication impairments (APA, 2000). Conversely, individuals with autism often have strengths in memory and visual processing (Ganz, 2007; Schneider & Goldstein, 2010). Today's educators are faced with the challenge to provide a high-quality education program by implementing evidence based practice (EBP) in the least restrictive environment (LRE) for students with autism.

Current and emerging education and disability policies promote the increased inclusion of students with ASD into general education classrooms (Cihak, 2011). Inclusive practices evolved from the passage of Public Law 94-142 (Education for All Handicapped Children Act) in 1975 to current legislation, which mandates that students with disabilities are to receive education services in the LRE, typically the general education classroom, whenever possible (Individuals with Disabilities Improvement Education Act, 2004). Additional legislation, such as No Child Left Behind (2001) and the Elementary and Secondary Education Act (1965), establishes high standards and requires the inclusion of students with disabilities in achievement systems. This legislation promotes education of students with disabilities in the general education classroom in order to meet state standards, requires the use of evidence-based practices, and increases accountability measures for all students. Due to the prevalence of autism and the laws supporting students with disabilities, it is very likely that general educators will teach at least one student with autism sometime during their career (Fittipaldi-Wert & Mowling, 2009).

Increased Prevalence Rates

The Centers for Disease Control and Prevention's Autism and Developmental Disabilities Monitoring (ADDM) Network (2014) estimated one in 68 children having a diagnosis of ASD. The Center for Disease Control and Prevention (CDC) compared results between the years and noticed an increase in estimated ASD prevalence of 23% when the 2008 ADDM data were compared with the data for 2006 and an estimated increase of 78% when the 2008 data were compared with the data for 2002 (CDC, 2012). The ratio of males diagnosed with ASD to females diagnosed with ASD averages 5:1 (Davidovitch, Hemo, Manning-Courtney, & Fombonne, 2013). An additional study was conducted (CDC, 2013) that surveyed parents and found a prevalence rate of one in 50 school-aged students have a diagnosis of ASD. The 2012 estimate of one in 88 is currently the accepted prevalence rate of ASD in the United States. Many researchers point to the idea that the change in prevalence rates might not be due to an increase in ASD but rather result from the changes in diagnosis criteria, increased awareness, increased willingness to undergo assessment and diagnosis, and the substitution of diagnoses (Volkmar, Lord, Bailey, Schultz, & Klin, 2004; Wing & Potter, 2002).

One reason for better diagnosis of ASD is the medical definition provided in the *Diagnostic and Statistical Manual for Mental Disorders* (DSM). The DSM-IV-TR described autism as a triad of symptoms that includes (a) social impairments, (b) repetitive behavior or obsessive interests, and (c) communication impairments (APA, 2000). The definition was further revised in the most current version of the DSM, and ASD is characterized in the DSM-5 by an individual's having both (a) deficits in social communication and social interaction and (b) restricted behaviors, interests, and activities (APA, 2014).

<u>Challenges to School Districts</u>

Characteristics of Autism Spectrum Disorder

Diagnosis of ASD under the DSM-5 requires that an individual meet criteria in four areas: (a) deficits in social communication and social interaction; (b) restrictive repetitive behaviors, interests, and activities (RRBs); (c) presence of symptoms in early childhood; and (d) symptoms' causing limits and impairment of everyday functioning (Wing, Gould, & Gillberg, 2011). Social impairment characteristics include difficulty with recognizing thoughts and feelings of others, poor eye contact, difficulty maintaining appropriate personal space, difficulty making or keeping friends, difficulty joining activities, and difficulty understanding jokes (Kamp-Becker et al., 2000). Students with autism frequently experience difficulty attending to, regulating, and understanding auditory input (Bryan & Gast, 2000). Additional characteristics of communication impairments include making sounds repeatedly, immediate or delayed echolalia, interpreting words or conversations literally, difficulty understanding figurative language, difficulty with rules of conversation, difficulty initiating or responding to social greetings, difficulty asking for help, and difficulty talking about interests of others (Kamper-Becker et al., 2000). Individuals diagnosed with ASD also commonly experience problems in organizing their environments, have difficulty when making transitions between activities (Dettmer, Simpson, Myles, & Ganz, 2000), and often depend on adults for staying on-task, completing activities, and transitioning (Bryan & Gast, 2000).

Legislation on Education for Individuals with ASD

The Education for All Handicapped Children Act of 1975 is the seminal legislation that guides special education services today. This law includes requirements such as (a) child find programs, (b) individualized education programs, (c) least restrictive environment, (d) nondiscriminatory assessment, (e) related services, (f) due process rights, (g) funding, and (h) a free and appropriate public education (Smith, 2005). This change in educational policy moved from discriminatory to inclusive legislation for individuals with disabilities, and the Education for All Handicapped Children Act was reauthorized as the Individuals with Disabilities Education Act (IDEA, 1997). The most current reauthorization of IDEA is the Individuals with Disabilities Education Improvement Act (IDEIA, 2004) and mandates that students with disabilities are to receive education services in the least restrictive environment (LRE), which has typically been considered to be the general education classroom (Hyatt & Filler, 2011).

The belief behind inclusive practices is that the achievement gap between students with disabilities and students without disabilities can be closed only if all students are provided the same educational opportunities (Kilanowski-Press, Foote, & Rinaldo, 2010). To close the achievement gap, No Child Left Behind (2001) requires the use of evidence-based practices in schools to improve the learning outcomes for all students. No Child Left Behind (2001) defines scientifically based research as “research that involved the application of rigorous, systematic, and objective procedures to obtain reliable and valid knowledge relevant to education activities and programs” (p. 126). *The Blueprint for Reform: The Reauthorization of the Elementary and Secondary Education Act* (U.S. Department of Education, Office of Planning, Evaluation and Policy Development, 2010) is a document that provides recommendations for future reauthorization of policy and focuses on ensuring that teachers are better prepared to meet the needs of diverse learners, assessments more accurately and appropriately measure the performance of students with disabilities, and districts and schools implement high-quality curricula and instructional supports to meet the needs of all students. These policies further justify the need for students with ASD to be afforded the appropriate research-based strategies in order to reach their full potential in the LRE.

Evidence-Based Practice for Students with ASD

The National Professional Development Center for Autism also provides a definition of EBP and considers an intervention to be evidence-based practice for individuals with ASD if efficacy is established through peer-reviewed research in scientific journals using (a) randomized or quasi-experimental study designs that include at least two studies, (b) single-subject designs that include at least five studies by three different investigators or research groups, or (c) a combination of evidence (Horner et al., 2005; Odom et al., 2005). Currently, the Center has identified 27 evidence-based practices, and the use of visual supports is included (NPDC-ASD, 2014).

Visual Activity Schedules

Wong et al. (2014) described visual supports as any visual display that supports the learner engagement in a desired behavior or skill without the need of prompts and includes visual schedules as an example of a visual support. Visual Activity Schedules (VAS) are an evidence-based practice (EBP) for students with ASD (Banda, Grimmet, & Hart, 2009; Dymond, Gilson & Myran, 2007; Meadan, Ostrosky, Triplett, Michna, & Fettig, 2011; Simpson, 2005; Simpson & Myles, 2008; Wong et al., 2014). Since children with ASD often have difficulty processing and retaining verbal information, VAS are used to maintain attention, assist in comprehension of spoken language, and organize environments (Lequia, Machalicek, & Rispoli, 2012). Visual activity schedules are a research-based intervention for individuals with autism that addresses areas of deficit as it capitalize on the visual strengths exhibited by many of these students (Banda et al., 2009; Dymond et al., 2007; Ganz, 2007; Meadan et al., 2011; Simpson, 2005; Simpson & Myles, 2008). Research strongly supports the use of VAS for increasing social skills (Banda & Grimmett, 2008; Betz, Higbee, & Reagon, 2008; Dauphin, Kinney, & Stromer, 2004; Kimball, Kinney, Taylor, & Stromer, 2004; Krantz, MacDuff, & McClannahan, 1993; Krantz & McClannahan, 1998; Machalicek et al., 2009; Morrison, Sainato, Benchaaban, & Endo, 2002; O’Reilley, Sigafoos, Lancioni, Edrisinha, & Andrews, 2005), independent engagement/on-task behavior (Bryan & Gast, 2000; Clarke, Dunlap, & Vaughn, 1999; Cuhadar & Diken, 2011; Krantz et al., 1993; Massey & Wheeler, 2000; MacDuff, Krantz, & McClannahan, 1993; Morrison et al., 2002; O’Reilley et al., 2005; Pierce & Schreibman, 1994; Watanabe & Sturmey, 2003), transition skills (Banda & Grimmett, 2008; Banda et al., 2009; Cihak, 2011; Dettmer et al., 2000; Dooley, Wilczenski, & Torem, 2001; Hall, McClannahan, & Krantz, 1995; MacDuff et al., 1993; McCoy, Mather, & Czoka, 2010; Schmit, Alper, Raschke, & Ryndak, 2000; Waters, Lerman, & Hovanetz, 2009), and decreasing problem behaviors (Clarke, Dunlap, & Vaughn, 1999; Dooley et al., 2001; Krantz et al., 1993; O'Reilley et al., 2005; Schmit et al., 2000; Waters et al., 2009) for individuals with ASD.

Technology for Students with ASD

The use of technology for students with ASD is not new, and interest in the past five years on the use of portable technologies for students with autism has grown (Mintz, Branch, March, & Lerman, 2012). Computers have become a modern classroom fixture (Kimball, Kinney, Taylor, & Stromer, 2003) and often are a preferred instructional medium for children with ASD (Stromer, Kimball, Kinney, & Taylor, 2006). A review of literature found five research studies that employed the use of computers as a mode of VAS (Cihak, 2011; Dauphin et al., 2004; Kimball et al., 2003; Kimball et al., 2004; Stromer et al., 2006).

Portable electronic devices such as the iPad are becoming a technology tool for teaching students with disabilities, but there is limited research on the use of these tools for elementary students with a diagnosis of ASD (Mechling, 2011). A small number of studies have been published on the use of portable mobile technologies for students with ASD, and database searches reveal some studies involving the use of iPads or iPods to implement research-based strategies (Burke, Anderson, Bowen, Howard & Allen, 2010; Cihak, Fahrenkrog, Ayres, & Smith, 2010; Kagohara, Sigafoos, Achmadi, O'Reilly, & Lancioni, 2012).

Kagohara et al. (2013) conducted a systematic review of literature of studies that involved iPods, iPads, and related devices for teaching individuals with developmental disabilities. Of the 15 studies that met criteria for inclusion in their review, 11 included interventions for individuals with ASD, with one study being sited in Mechling's (2011) review of literature (Achmadi et al., 2012; Burke et al., 2010; Flores et al., 2012; Kagohara, Sigafoos et al., 2012; Kagohara, van der Meer et al., 2012; Kagohara et al., 2010; van der Meer, Didden et al., 2012; van der Meer, Sutherland, O'Reilly, Lancioni, & Sigafoos, 2012; van der Meer et al., 2011; van der Meer, Kagohara et al., 2012). Further database searchers, journal searches, and review of references yielded an additional four studies that implemented an iPad or iPod for interventions with individuals with ASD (Burton, Anderson, Prater, & Dyches, 2013; Cardon, 2012; Johnson, Blood, Freeman, & Simmons, 2013; Mechling & Savidge, 2011).

Statement of the Problem

Policy and legislation support the inclusion of students with ASD in the general education setting and the implementation of EBP in the field of education. No Child Left Behind (2001) brought an increased emphasis on using EBP to increase student outcomes, while IDEIA (2004) mandated that students with disabilities be required to receive education services in the least restrictive environment possible for learning. Even with educational policy, the Special Education Elementary Longitudinal Study (SEELS) reported that "about 60% of students with autism spend less than half of their school day in general education classrooms," and students with autism are "about half as likely as students with all other disabilities to receive language arts and mathematics instruction in general education classrooms" (Sanford, Levine, & Blackorby, 2008, p. 11-12).

Visual Activity Schedules are tools that are considered to be EBP for students with autism and can supplement verbal directions when students have deficits in auditory processing

(Banda et al., 2009). Research on VAS has been used to promote acquisition and maintenance of complex vocational tasks and to increase independent activity in various settings and under various severities of ASD diagnosis (Hall et al., 1995; Lequia et al., 2012). Transition problems can be especially evident when children with ASD are taught in general education or inclusive settings, and with the current push for inclusive educational models, the use of activity schedules for children with ASD can be an important behavioral intervention component for schools to consider at the classroom and individual student level (Banda et al., 2009). There is a gap in the literature on the implementation of VAS in inclusive settings with only three of the 20 research studies reviewed in this proposal being conducted in an inclusive classroom environment.

Research and clinical practice have suggested that computers and technology may have positive effects on attention and performance in students with autism when compared to other forms of instruction (Dauphin et al., 2004). A review of literature found five research studies that employed the use of computers as a mode of VAS (Cihak, 2011; Dauphin et al., 2004; Kimball et al., 2003; Kimball et al., 2004; Stromer et al., 2006). All of the studies used Microsoft PowerPoint to create the VAS and included a component of video-modeling. Although results of the studies included increased engagement, increased independent transitions, and a reduction in problem behavior, the lack of portability of computers could be seen as a mark against them (Stromer et al., 2006).

Portable electronic devices, specifically the iPad, are becoming a tool for teaching students with disabilities, and research is underway to determine the effectiveness of this potential instructional tool, but there are few studies available on the use of iPads for students with ASD (Mechling, 2011). Research involving elementary students with a diagnosis of ASD is needed to determine whether implementing the iPad is an effective strategy to increase academic, communicative, and behavioral outcomes.

In a systematic review of literature Mechling (2011) found that of the 21 studies that met criteria for inclusion only five were conducted with students with ASD and only two of the 21 studies included elementary students. Additional research is needed to determine the effectiveness of implementing VAS delivered via the iPad to increase academic, communicative, and behavioral outcomes of students with ASD before it can be considered an evidence-based practice under NCLB or the National Professional Development Center on Autism Spectrum Disorders requirements.

Purpose of the Study

The purpose of this research study was to examine the impact of VAS delivered via the iPad, compared to a paper-based VAS, on the percentage of on-task behavior and median transition time for students with ASD during academic center activities in an inclusive classroom setting. This study took place in a public charter school in Orange County, Florida, that provides instruction for students with autism spectrum disorder in inclusive classroom settings. This study expands on the already established EBP of visual activity schedules for students with ASD (Banda et al., 2009; Dymond et al., 2007; MacDuff et al., 1993; Meadan et al., 2011; Simpson, 2005; Simpson & Myles, 2008) by examining how the use of an iPad visual activity schedule application may influence participants' percentage of on-task behavior and duration of time transitioning between academic literacy center activities for elementary students with a diagnosis of ASD when compared to a paper-based VAS.

Research Questions

1. Is there a difference between an iPad VAS application and a paper-based Visual Activity Schedule for the percentage of on-task student behavior for students with Autism Spectrum Disorder during literacy center activities?
2. Is there a difference between an iPad VAS application and a paper-based Visual Activity Schedule for the duration of transition time, as measured in seconds, for students with Autism Spectrum Disorder during literacy center activities?

Dependent Variables

On-task was defined as the participants' (a) visually attending to the appropriate scheduled materials; or (b) looking at their picture activity schedule; or (c) manipulating the appropriate scheduled materials (i.e., as they were designed to be used); or (d) looking at or attending to the adult teaching the center (Bryan & Gast, 2000; MacDuff et al., 1993; Pelios, Macduff, & Axelrod, 2003).

Transition time was defined as the total time it took for the students to transition from one academic center to the next academic center on their visual activity schedule when given a signal to transition. The timer began when the cue to transition was given, which was designated by the sound of the teacher timer, and concluded when the student was in the academic center area and engaging in on-task behavior for that activity center. Transition time was recorded for the three transitions between the four small-group literacy activity centers. A median transition time was reported for data analysis.

Independent Variable

The independent variables for this study include a VAS delivered via iPad and a paper-based VAS. Activity schedules for both the paper-based VAS and the VAS delivered via iPad have identical visual and textual representations of scheduled activities, but one was a paper-based VAS (see Appendix A) and one was a VAS via the iPad application (see Appendix B).

Research Methods

Research Design

An alternating-treatment, single-subject research design was used to determine whether a divergence exists between VAS delivered via iPad and the paper-based VAS. An alternating-treatment design is often used to compare two interventions and can be used to compare two variations of the same intervention, so it is appropriate for use in this study (Alberto & Troutman, 2006; Gast, 2010). Each student received either the paper-based VAS or the VAS delivered via iPad, depending on the random assignment of treatment. An alternating-treatment design is also appropriate for answering the research questions because it can be "used with acceleration and deceleration behaviors," such as increasing on-task behavior and decreasing transition time (Gast, 2010, p. 248).

Participants

A convenience sample of three students with a primary diagnosis of ASD was selected as participants for this study. Criteria for participant selection included (a) a diagnosis of ASD as stated on the Individualized Education Plan (IEP), (b) grade level K-1, (c) receipt of instruction through Language Arts activity centers taught within one classroom, and (d) difficulty with independent on-task behavior as reported by the participant's teacher. Criteria for participation were determined by reviewing the student participants' IEPs. There were four students that met criteria for selection in this study. However, one student was removed from the study by the teacher and parents during baseline data collection due to intensive behavioral needs. Therefore, only three participants were included in this study.

Data Collection

Baseline data were collected for five observational periods prior to the implementation of treatment conditions. A minimum of five observations per treatment condition was implemented in this study, so participants used each VAS for the entire reading block five different times. Data for on-task behavior were collected through a 10-second whole-interval measurement to obtain a percentage of on-task behavior for each observation period. Duration of transition time was recorded for the three transitions between the small-group literacy centers, and a median transition time was reported for data analysis. A timer began once a cue to transition was given to the whole class, as signaled by the teacher timer, and stopped once the participant was at the appropriate center and engaging in on-task behavior for the literacy activity.

Data Analysis

Visual analysis was used to analyze data from this study. Visual analysis allows the researcher to compare percentage of on-task behavior and median transition time for participants (Gast, 2010). Visual analysis was used to determine whether one technique was more effective than the other by looking at a divergence of data to determine whether a clear difference existed.

Calculation of percentage of non-overlapping data (PND) was also be used to compare each condition being alternated against the other. The first data point for the iPad VAS was compared to the first data point for the paper-based visual activity schedule, the second data point for iPad VAS was compared to the second data point for the paper-based visual activity schedule, and so on (Richards, Taylor, & Ramasamy, 2014).

Reliability and Validity

All observation sessions were recorded by the principal investigator using two digital recording devices to create a permanent product of the study and increase reliability. Data were collected by two independent observers to remove any researcher bias. The observers completed training on data collection prior to collecting data with an interobserver agreement (IOA) of at least 80%. One observer collected data for all observation periods, and the second observer collected data for 40% of all observations. IOA was calculated using the point-by-point calculation (i.e., agreements/ (agreements + disagreements) X 100; Gast, 2010), with a minimum of 80% agreement required (Kratochwill et al., 2013).

Many threats to internal validity are not applicable to alternating treatment designs due to the relatively short time frame of the study (Gast, 2010). Additionally, threats to extra-experimental events would typically influence performance under both conditions (Gast, 2010). However, alternating treatment designs are subject to multi-treatment interference, or carryover effects, and sequential confounding effects. The researcher attempted to minimize multi-treatment interference, or carryover effects, by implementing only one condition per day and attempted to control for sequential confounding effects by not having more than two consecutive sessions of the same condition (Gast, 2010).

CHAPTER TWO: LITERATURE REVIEW

Introduction

The beliefs, treatment, and education of individuals with autism spectrum disorders (ASD) have undergone many changes throughout our history. Although the history of autism begins in the 1900s, individuals who displayed characteristics of ASD have been documented throughout history (Wing & Potter, 2002). Dr. Eugene Bleuler first coined the term “autism” in 1912 to describe individuals who were completely withdrawn from the social world (Bleuler, 2011). Since then, research in the area of autism has helped shape the diagnosis and education of individuals with ASD.

The diagnosis and education of students with ASD continues evolve in order to improve the lives of individuals with ASD. As the diagnostic history evolved, changes in the definition of autism, improved diagnostic tools, and research on suspected causes have been documented. Educational policy has evolved from seclusion to inclusive education, with the Individuals with Disabilities Education Improvement Act (IDEIA, 2004) mandating that students with disabilities are to receive education services in the least restrictive environment, and No Child Left Behind (NCLB, 2001), requiring the use of evidence-based practices (EBP) in schools to improve the learning outcomes for all students . This chapter discusses these changing trends and provides information about current EBP, including the use of Visual Activity Schedules (VAS) and the use of technology for students with ASD.

History of Autism

The term “autism” was first coined by Dr. Eugene Blueler, a Swiss psychiatrist. Blueler considered autism to be another form of schizophrenia in which individuals with schizophrenia have deficits in social skills (Rimland, 1964). Almost 30 years later two other pioneers of autism, Leo Kanner and Hans Asperger, wrote about individuals who shared similar characteristics to those described by Blueler. Leo Kanner was a child psychiatrist who conducted case studies of 11 children who exhibited common behaviors, including (a) withdrawal from others, (b) insistence on sameness, and (c) deficits in communication and language skills (Kanner, 1943). Hans Asperger was a pediatrician who completed his doctoral thesis on students who had varied intelligence but shared common features such as interest in specific subjects, limited attention, difficulties with learning, and poor motor skills. He also noticed unique use of eye contact, speech patterns, facial expressions, and speech patterns (Simpson & Myles, 2008). Asperger’s work was not widely known in the English-speaking world until the 1980s, when his work was translated from German to English. It was also in the 1980s that autism was officially added to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM), and autism research really took off.

Historical Trends of Diagnosis

Definition

The definition for ASD has continued to change since its formal introduction into the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) in 1980. The DSM-III recognized “infantile autism” as a pervasive developmental disorder-not otherwise specified (PDD-NOS)

(APA, 1980). In 1987, the DSM was revised and the name changed from "infantile autism" to "autistic disorder" (APA, 1987). It wasn't until 1994 that Asperger Syndrome was included in the updated DSM-IV. The DSM-IV not only included the diagnosis of Asperger's, but also included Childhood Disintegrative Disorder (CDD), and Rett's Syndrome (APA, 1994). Revisions were made to the DSM-IV in 2000. The DSM-IV-TR described autism as a triad of symptoms that includes (a) social impairments, (b) repetitive behavior or obsessive interests, and (c) communication impairments (APA, 2000). Additionally, the subcategories of autistic disorder and PDD-NOS were included under the autism spectrum definition in the DSM-IV-TR. The most current version of the DSM was released in May 2013 and made revisions to the definition and criteria for ASD. The DSM-5 includes the name Autism Spectrum Disorder to reflect a scientific consensus that the four previously separate disorders (autistic disorder, Asperger's disorder, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified) are actually a single condition (APA, 2013). ASD is characterized in the DSM-5 by an individual having both (a) deficits in social communication and social interaction and (b) restricted behaviors, interests, and activities.

Along with the DSM, various organizations have also provided definitions for ASD. Organizations such as the Autism Society of America, the World Health Organization, and the United States Department of Education have definitions for ASD. The Autism Society of America defines autism as a "complex developmental disability that typically appears during the first three years" and is characterized by specific behaviors that differentially affect individuals to varying degrees (http://www.autism-society.org/about-autism/). The World Health Organization defines the disorder by the presence of impaired development before the age of three, presence of abnormal functioning in social interaction, restricted and repetitive behaviors, and abnormalities in communication (WHO, 1993). The U.S. Department of Education defines autism by the onset of developmental delays prior to the age of three, impairments in communication and social interaction, the engagement in repetitive and stereotyped behaviors, difficulty with change in environment to daily routines, and unusual responses to sensory input (IDEA, 1997). As definitions of ASD changed throughout the years the diagnosis and the use of diagnostic tools have changed as well.

Diagnosis and Diagnostic Tools

As changes in the definitions of ASD occurred, the diagnostic criteria also experienced dramatic changes since the disability's formal recognition as a condition. Prior to infantile autism's being included in the DSM-III, individuals who displayed characteristics of ASD were often diagnosed with childhood schizophrenia (Ward, 1970) or early infantile autism. Kanner and Eisenberg (1956) published a list of diagnostic criteria that included the behavioral features of aloofness and indifference to others, the intense resistance to change in an individual's own repetitive routines, and the criteria that these features needed to be present by 24 months. When the DSM was revised in 1987 it included and refined the criteria for "autistic disorder" to include characteristics grouped into areas of social interaction, communication, and restrictive activities (Wing & Potter, 2002). Social interaction, communication, and restrictive activities are the three characteristics of behavior that we have seen present in continued revisions of the definition and diagnosis of ASD, until the release of the DSM-5.

For a diagnosis of ASD under the DSM-5 an individual must meet criteria in four areas: (a) individuals must have deficits in social communication and social interaction; (b) individuals must have restrictive repetitive behaviors, interests, and activities (RRBs); (c) symptoms must be present in early childhood; and (d) symptoms together must limit and impair everyday functioning (Wing et al., 2011). To meet criteria in the area of deficits in social communication and social interactions all three sub-criteria must be met: (a) deficits in social-emotional reciprocity; (b) deficits in nonverbal communicative behaviors used for social interaction; and (c) deficits in developing and maintaining relationships, appropriate to developmental level. To meet criteria in the area of RRBs, at least two of the sub-criteria must be met: (a) stereotyped or repetitive speech, motor movements, or use of objects; (b) excessive adherence to routines, ritualized patterns of verbal and nonverbal behavior, or excessive resistance to change; (c) highly restricted, fixated interests that are abnormal in intensity or focus; or (d) hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of environment (APA, 2013).

Today there are a variety of diagnostic tools to measure criteria for the screening and diagnosis of ASD. Diagnostic screening and diagnostic tests for ASD are norm-referenced, and standardized administration is required to obtain valid results. Some of the most common diagnostic tools available include the Autism Diagnostic Observation System (ADOS-2), Autism Diagnostic Interview-Revised (ADI-R), Autism Screening Instrument for Educational Planning 2nd Edition (ASIEP-2), Childhood Autism Rating Scale 2nd Edition (CARS-2), and the Gillam Autism Rating Scale 2nd Edition (GARS-2). These diagnostic tools are used with children as young as 18-months-old to adults of the age of 22 years (Klose, Plotts, Kozeneski, & Skinner-Foster, 2012). These diagnostic tools look at criteria in the areas of nonverbal communication, social interaction, verbal communication, repetitive and/or stereotyped activities, resistance to environmental change or change in daily routines, and response to sensory experiences. All of these areas are critical to the successful education of students with ASD, especially in the general education setting (Simpson & Myles, 2008).

Suspected Causes

Past Beliefs

Interest in the suspected causes of ASD has been an increasing force in the media, possibly due to the concern about increased prevalence rates. One of the first suspected causes of ASD was the idea of the “refrigerator mother” that was described by Bruno Bettelheim. Bettelheim felt that the emotional difficulties of mothers led to their children’s being diagnosed with ASD. It was Bernard Rimland who challenged this idea and wrote a book on the thought that ASD was biological and not caused by poor parenting (Rimland, 1964). More recently, fueled by the observed prevalence rates, many presume that environmental causes might be the reason behind rising rates (Deth, Muratore, & Benzecry, 2010). One thought that had gained attention was that ASD is caused by immunizations due to the mercury in the thimerosal preservative used (Bernard, Enayati, Roger, Binstock, & Redwood, 2002), but this theory has been proven false (Fombonne & Chakrabarti, 2001; Shultz, 2010). Many researchers point to the idea that the change in prevalence rates might not be due to an increase in ASD, but rather the fact that changes in diagnosis criteria, increased awareness, increased willingness to undergo assessment and diagnosis, and the substitution of diagnoses are the driving forces behind the increased prevalence rates (Volkmar et al., 2004; Wing & Potter, 2002).

Neurological Research in the Area of ASD

Advancements in technology have facilitated neurological research to provide more conclusive information regarding suspected causes. Many characteristics of cognitive functioning for individuals with ASD are outcomes of weak central coherence or deficits in executive functioning, which are the result of physiological differences in the brain (Harrison & Hare, 2004; Klintwall et al., 2011). In 1998, Uta Frith proposed that cognitive differences might be explained by a concept known as central coherence or the general tendency to integrate information into a meaningful whole. Researchers have studied this theory and support that it has the potential to explain the non-holistic, piecemeal perceptual style characteristic of ASD. (Baron-Cohen & Swettenham, 1997). Executive functioning is considered to encompass a broad group of mental processes, including working memory, behavior inhibition, planning, mental flexibility, task initiation and performance monitoring, and self-regulation (Simpson & Myles, 2008). Researchers found that the prefrontal cortex of the brain, known as the frontal lobes, is responsible for these functions (Baron-Cohen & Swettenham, 1997). The brains of many individuals with ASD are bigger and heavier than others' without a diagnosis of ASD, and the abnormal growth patterns result in poor neural connections, resulting in executive functioning impairments (Redcay & Courchesne, 2005). Executive functioning is the term used to describe problem-solving behaviors, including (a) forming abstract concepts, (b) having a flexible sequenced plan of action, (c) focusing on sustained attention and mental effort, (d) rapidly retrieving relevant information, (e) being able to self-monitor and self-correct as a task is performed, and (f) being able to inhibit impulsive responses (Simpson & Myles, 2008), all skills necessary for success in the educational environment.

Historical Trends in Education

Inclusive Education

Inclusive practices evolved from the passage of Public Law 94-142, the Education for All Handicapped Children Act, in 1975, and the Individuals with Disabilities Education Improvement Act (IDEIA, 2004. One of the first legislative policies towards inclusion of individuals with disabilities was the Americans with Disabilities Act (1990), which made it illegal to discriminate against anyone with a disability in the areas of employment, public service, transportation, public accommodations, and telecommunications (Sandall, McLean, & Smith, 2000). Legislation continued to be enacted to acknowledge the rights of individuals with disabilities to be protected from discrimination, and in 1997 the Individuals with Disabilities Education Act (IDEA) was reauthorized and stated that students with disabilities are to be included in state- and district-wide assessments (Skiba et al., 2008). IDEA was again reauthorized in 2004 and continued to include previous rights for students with disabilities, such as the right to (a) be educated in the least restrictive environment, (b) a free and appropriate public education, (c) include parental involvement, (d) nondiscriminatory assessment, (e) zero-reject from ages 6-17, (f) individualized education programs, and (g) child find programs (Smith, 2005).

The belief behind inclusive practices is that the achievement gap between students with disabilities and students without disabilities can be closed only if both students are provided the same educational opportunities (Kilanowski-Press et al., 2010). *The Blueprint for Reform: The Reauthorization of the Elementary and Secondary Education Act* (2010) focused on ensuring that teachers are better prepared to meet the needs of diverse learners, assessments more accurately and appropriately measure the performance of students with disabilities, and districts and schools implement high-quality curricula and instructional supports to meet the needs of all students.

Despite educational policy, the Special Education Elementary Longitudinal Study (SEELS) reported that “about 60% of students with autism spend less than half of their school day in general education classrooms,” and students with autism are “about half as likely as students with all other disabilities to receive language arts and mathematics instruction in general education classrooms” (Sanford et al., 2008, p. 11-12). These data point to the need for students with ASD to have the appropriate supports implemented to ensure successful education in the general education classroom setting. Necessary supports have been identified as reduced class size, presence of paraprofessionals, adequate teacher planning time, availability of trained related-service providers, and existence of programs to ensure supportive attitudes toward students with ASD. (Simpson, deBoer-Ott, & Myles, 2003).

Evidence-Based Practice

No Child Left Behind (2001) requires the use of evidence-based practices in schools to improve the learning outcomes for all students. Evidence-based practices are the gold standard of best practices of teaching and can be defined as interventions that are scientifically research based. No Child Left Behind (2001) defines scientifically based research as “research that involved the application of rigorous, systematic, and objective procedures to obtain reliable and valid knowledge relevant to education activities and programs” (p. 126). These policies further justify the need for students with ASD to have the appropriate research-based strategies in order to reach their full potential.

Visual Activity Schedules

Students with autism often experience difficulty with auditory processing (Banda & Grimmett, 2008; Bryan & Gast, 2000; Cihak, 2011; Dettmer et al., 2000; Fittipaldi-Wert & Mowling, 2009; Ganz, 2007; Lequia et al., 2012; Massey & Wheeler, 2000), communication (Absoud, Parr, Salt, & Dale, 2011; Banda & Grimmett, 2008; Banda et al., 2009; Dettmer et al., 2000; Lequia et al., 2012; Schmit et al., 2000; Waters et al., 2009), organizing their environment (Dettmer et al., 2000; Morrison et al., 2002), independently remaining engaged (Banda & Grimmett, 2008; Bryan & Gast, 2000; Ganz, 2007; Lequia et al., 2012; Massey & Wheeler, 2000), and transitioning (Banda & Grimmett, 2008; Banda et al., 2009; Bryan & Gast, 2000; Dettmer et al., 2000; Lequia et al., 2012; Schmit et al., 2000; Waters et al., 2009). Conversely, individuals with autism are typically characterized as having strengths in memory and visual processing (Ganz, 2007; Massey & Wheeler, 2000; Schneider & Goldstein, 2010; Vedora, Ross, & Kelm, 2008). Since children with ASD often have difficulty processing and retaining verbal information, VAS are used to maintain attention, assist in comprehension of spoken language, and organize environments (Lequia et al., 2012).

Visual activity schedules are tools that present an abstract concept, such as time, in a more concrete and manageable form (Banda & Grimmett, 2008; Ganz; 2007; Simpson & Myles, 2008) and allow students to anticipate upcoming events and activities, develop an understanding of time, and facilitate the ability to predict change (Fittipaldi-Wert & Mowling, 2009; Meadan et al., 2011). Research on VAS have included the use of various formats, including the use of photographs, line drawings, colored drawing, and text (Banda & Grimmett, 2008; Banda et al., 2009; Cihak, 2011; Lequia et al., 2012; Stromer et al., 2006).

It is important to determine which level of visual representation is appropriate for each student according to each student's reading level and understanding of abstract concepts (Ganz, 2007; Simpson & Myles, 2008). Typically VAS are organized in a first/then format in a vertical (top to bottom) or horizontal (left to right) frame to sequence events or activities (Ganz, 2007; Stromer et al., 2006). VAS can be in the form of notebooks, picture books, notecards, sentence strips, checklists, or computers through the use of PowerPoint (Cihak, 2011; Kimball et al., 2003; Kimball et al., 2004; Schneider & Goldstein, 2010; Stromer et al., 2006; Vedora et al., 2008). A strength of VAS is that they are flexible and can be used with a whole class or individually and have been implemented in multiple settings, including home, classroom, and vocational environments to increase social skills, engagement, and transition skills (Banda & Grimmett, 2008; Hall et al., 1995; Kimball et al., 2003, Kimball et al., 2004; Massey & Wheeler, 2000; Waters et al., 2009).

Implementation of VAS has been shown to increase social skills, including social initiations and peer engagement for individuals with autism (Banda & Grimmett, 2008; Kimball et al., 2004; Schneider & Goldstein, 2010). A computer search using ERIC and a review of article references revealed seven studies that implemented VAS with individuals diagnosed with ASD to increase social skills. All participants in the following studies included male participants with a diagnosis of autism, with the exception of two studies that included female participants (Betz et al., 2008; Morrison et al., 2002). Settings included home-based interventions (Dauphin et al., 2004; Krantz et al., 1993), a classroom in a separate day school for children with disabilities (Krantz & McClannahan, 1998; Machalicek et al., 2009; O'Reilly et al., 2005), one classroom that was not specified (Betz et al., 2008), and one study that was completed in an inclusive classroom (Morrison et al., 2002). All studies resulted in increased social skills for participants. Table 1 shows the summary of the settings, research design, data collection procedure and results of VAS studies conducted with individuals with autism to target social skills.

Table 1: Summary of VAS Studies Targeting Social Skills

Reference	Participant characteristics	Setting	Design	Data collection procedure	Results
Betz et al. (2008)	Six 4 to 5-year-olds; 5 males and 1 female	Play area of participants' classrooms (not specified)	ABAB reversal design	20 second momentary time sampling	Increased peer engagement in teaching condition
Dauphin et al. (2004)	3- year-old male	Home-based instruction	Matrix training	Frequency of tasks completed within 10 seconds	Increased engagement in play activities and learned social scripts
Krantz et al. (1993)	8-year-old male 6-year-old male 7-year-old male	Home-based instruction	Multiple baseline across participants	Frequency for social initiations	Increase in social engagement and social initiations for all participants
Krantz & McClannahan (1998)	5-year-old male 4-year-old male 4-year-old male	Classroom in a separate day school for children with ASD	Multiple baseline across participants	Event recording	Increased social engagements for all participant
Machalicek et al. (2009)	6-year-old male 7-year-old male 12-year-old male	Classroom in a separate day school for children with development al disabilities and ASD	Multiple baseline across participants	10 second partial interval recording	Play increased for all participant

Reference	Participant characteristics	Setting	Design	Data collection procedure	Results
Morrison et al. (2002)	4-year-old male 5-year-old female 3-year-old male 5-year-old female	Inclusive preschool classroom	Multiple baseline across participants	Event recording	Increase in play correspond-ence
O'Reilly et al. (2005)	12-year-old male	Classroom in a separate day school for children with ASD	ABAB reversal design	10 second partial interval recording	Increase in social engagement

VAS are an EVP used to address time on task and increase independence for individuals with autism (Ganz, 2007). Individuals with ASD are capable of completing a variety of activities but often depend on prompts to do each one separately; VAS are empirically validated to promote greater independence (Kimball et al., 2004). A computer search using ERIC and a review of article references revealed 10 studies that implemented VAS with individuals diagnosed with ASD to target engagement or on-task behavior. All participants in the following studies included male participants with a diagnosis of autism, with the exception of one study that included a female participant (Morrison et al., 2002). Settings included home-based interventions (Clarke et al., 1999; Krantz et al., 1993; Pierce & Schreibman, 1994), a classroom in a separate day school for children with disabilities (O'Reilly et al., 2005), a resource classroom in the local elementary school (Bryan & Gast, 2000), inclusive preschool classrooms

(Massey & Wheeler, 2000; Morrison et al., 2002), clinic settings (Cuhadar & Diken, 2011; Pierce & Schreibman, 1994), a community-based group home (MacDuff et al., 1993), and an adult service program (Watanabe & Sturmey, 2003). All studies resulted in increased engagement for participants. Table 2 shows the summary of the settings, research design, data collection procedure, and results of VAS studies conducted with individuals with autism to target engagement.

Table 2: Summary of VAS Studies Targeting Engagement

Reference	Participant characteristics	Setting	Design	Data collection procedure	Results
Bryan & Gast (2000)	8-year-old male 8-year-old male 7-year-old male 8-year-old female	Resource classroom in local elementary	ABAB reversal design	1 minute momentary time sampling	Increased independent on-task and on-schedule behavior
Clarke et al. (1999)	10-year-old male	Home-based intervention	ABAB reversal design	10 second partial interval	Increase in on-task behavior
Cuhander & Diken (2011)	Three 4 to 6-year-old male	Training office in private educational institution	Multiple probe design with probe conditions across subjects	Frequency of correct reactions to schedule-percentage of correct reactions recorded	Increased engagement with activity
Krantz et al. (1993)	8-year-old male 6-year-old male 7-year-old male	Home-based instruction	Multiple baseline across participants	30 second momentary time sampling	Increase in engagement
MacDuff et al. (1993)	9-year-old 9-year-old 11-year-old 14-year-old	Community-based group home	Multiple baseline across participants	60 second momentary time sampling	Increased in on-task and on-schedule behavior

Reference	Participant characteristics	Setting	Design	Data collection procedure	Results
Massey & Wheeler (2000)	4-year-old	Inclusive preschool classroom	Multiple baseline across activities	5 second momentary time sampling	Increased levels of task engagement
Morrison et al. (2002)	4-year-old male 5-year-old female 3-year-old male 5-year-old female	Inclusive preschool classroom	Multiple baseline across participants	10 second partial interval (rotated between participants)	Increase on-task behaviors
Pierce & Schreibman (1994)	8-year-old male 9-year-old male 6-year-old male	Home-based instruction (8 and 9-year-olds) Clinic (6-year-old)	Multiple baseline across behaviors	10 second partial interval	Increase in on-task daily living skills in absence of treatment provider
O'Reilly et al. (2005)	12-year-old male	Classroom in a separate day school for children with ASD	ABAB reversal design	10 second whole interval	Increased levels of engagement
Watanabe et al. (2003)	22-year-old male 40-year-old male 30-year-old male	Adult service program for individuals with developmental and behavioral disorders	Multiple baseline across participants	1 minute momentary time sampling	Increase in time on-task

Students with ASD have difficulty with transitions, which can limit their independence, and visual activity schedules are a promising strategy to support transitioning needs (Banda et al., 2009). Transitions between activities and settings can be difficult for students with ASD due to difficulty predicting schedule of activities, but VAS can aid students with ASD by sequencing tasks pictorially or in writing (Dettmer et al., 2000). A computer search using ERIC and a review of article references revealed seven studies that implemented VAS with individuals diagnosed with ASD to increase independent transitions. All participants in the following studies included male participants with a diagnosis of autism. Settings included home-based and community-based interventions (Dettmer et al., 2000; MacDuff et al., 1993), a classroom in a separate day school for children with disabilities (Dooley et al., 2001; Schmit et al., 2000; Waters et al., 2009), a self-contained classroom in the local elementary school (Schmit et al., 2000), an elementary school setting not specified (Hall et al., 1995), and a middle school setting not specified (Cihak, 2011). All studies resulted in increased independent transitioning skills for participants. Table 3 shows the summary of the settings, research design, data collection procedure, and results of VAS studies conducted with individuals with autism to target transition skills.

Table 3: Summary of VAS Studies Targeting Transition

Reference	Participant characteristics	Setting	Design	Data collection procedure	Results
Cihak (2011)	13-year-old male 11-year-old female 12-year-old male 13-year-old male	Middle school classroom (not specified) 2 participants in the same class at different schools	Alternating treatment design	Event recording	Increased transitions 3 3participants using VAS, 2 participants using video modeling, 1 participant in both conditions
Dettmer et al. (2000)	7-year-old male 5-year-old male	Community-based instruction Home-based instruction	ABAB reversal design	Cumulative latency	Decreased latency time for transition
Dooley et al. (2001)	3-year-old male	Separate day school for students with disabilities	A-BC-B	Frequency	Increased compliance with transitioning
Hall et al. (1995)	8-year-old male 8-year-old male 7-year-old male	Elementary school (not specified)	Multiple baseline	1 minute momentary time sampling of prompts	Increased independent transition
MacDuff et al. (1993)	9-year-old 9-year-old 11-year-old 14-year-old	Community-based group home	Multiple baseline across participants	60 second partial interval for prompts	Increase independent transitions

Reference	Participant characteristics	Setting	Design	Data collection procedure	Results
Schmit et al. (2000)	6-year-old male	Self-contained classroom in local school	Multiple baseline across settings	Frequency of transitions without tantrums	Increased transitions
Waters et al. (2009)	6-year-old male 6-year-old-male	Separate day school for students with disabilities	A-C-B-D BL-VS-DRO and VAS-DRO only	Frequency of transitions without problem behavior-percentage out of 10 trials	Increased transitions with DRO and VAS

Individuals with ASD may exhibit problem behaviors, including stereotypic behaviors; verbal and/or physical aggression; self-injurious behaviors; and hyper- or hyposensitivity to sounds, smells, taste, etc. (Banda & Grimmett, 2008). Although not inherent in ASD, aggressive behaviors are more prevalent in individuals with ASD when compared to those with other developmental disabilities or the general population (Hodgetts, Nicholas, & Zwaigenbaum, 2013). VAS play an important role in decreasing problem behaviors and prompt dependency and increasing compliance for individuals with ASD (Cuhadar & Diken, 2011). A computer search using ERIC and a review of article references revealed six studies that implemented VAS with individuals diagnosed with ASD to decrease problem behaviors. All participants in the following studies included male participants with a diagnosis of autism. Settings included home-based interventions (Clarke et al., 1999; Krantz et al., 1993), a classroom in a separate day school for children with disabilities (Dooley et al., 2001; O'Reilly et al., 2005; Waters et al., 2009), and a self-contained classroom in the local elementary school (Schmit et al., 2000). None of the studies that targeted problem behaviors, including disruptive and aggressive behaviors, was conducted in an inclusive setting. All studies resulted in decreased problem behaviors for participants. Table 4 shows a summary of the settings, research design, data collection procedure, and results of VAS studies conducted with individuals with autism to target problem behavior.

Table 4: Summary of VAS Studies Targeting Problem Behavior

Reference	Participant characteristics	Setting	Design	Data collection procedure	Results
Clarke et al. (1999)	10-year-old male	Home-based intervention	ABAB reversal design	10 second partial interval	Decrease in disruptive behavior
Dooley et al. (2001)	3-year-old male	Separate day school for students with disabilities	A-BC-B	Frequency	Decrease in distressed vocalizations and aggressive behavior
Krantz et al. (1993)	8-year-old male 6-year-old male 7-year-old male	Home-based instruction	Multiple baseline across participants	15 second partial interval	Decrease in disruptive behavior
O'Reilly et al. (2005)	12-year-old male	Classroom in a separate day school for children with ASD	ABAB reversal design	10 second partial interval	Decreased levels of self-injury
Schmit et al. (2000)	6-year-old male	Self-contained classroom in local school	Multiple baseline across settings	Frequency of transitions without tantrums	Increased transitions without tantrums
Waters et al. (2009)	6-year-old male 6-year-old-male	Separate day school for students with disabilities	A-C-B-D BL-VS-DRO and VAS-DRO only	Frequency of transitions without problem behavior-percentage out of 10 trials	Decrease in Decrease in disruptive and aggressive behavior with DRO and VAS

Technology for Students with Autism Spectrum Disorder

The use of technology for students with ASD is not new, and interest in the past five years on the use of portable technologies for students with autism has grown (Mintz et al., 2012). Additionally, the computer has become a modern classroom fixture (Kimball et al., 2003) and often is a preferred instructional method for children with ASD (Stromer et al., 2006). A review of literature found seven research studied that employed the use of computers as a mode of VAS (Dauphin et al., 2004; Cihak, 2011; Kimball et al., 2003; Kimball et al., 2004; Mechling & Ayers, 2012; Mechling & Youhouse, 2012; Stromer et al., 2006). All of the studies used Microsoft PowerPoint to create the VAS and included a component of video-modeling. Although results of the studies included increased engagement, increased independent transitions, and a reduction in problem behavior, the lack of portability of computers could be seen as a mark against them (Stromer et al., 2006).

Portable electronic devices such as the iPad are becoming a technology tool for teaching students with disabilities, but there is limited research on the use of these tools for elementary students with a diagnosis of ASD (Mechling, 2011). Of the few studies available on the use of portable mobile technologies for students with ASD, database searches reveal investigations of the use of iPads or iPods to implement research-based strategies such as video modeling and performance cue systems (Burke et al., 2010; Cihak, Fahrenkrog et al., 2010; Kagohara, Sigafoos et al., 2012). These studies not only resulted in increased appropriate behavioral outcomes, but also increased independence for students with ASD who used the iPad or iPod. In a review of literature, Mechling (2011) found only 21 studies that (a) used a quasi-experimental or single-subject design, (b) were published in a peer-reviewed journal in English, (c) evaluated a form of portable electronic device (handheld computer, cellular phone, or MP3 player), and (d) involved participants diagnosed with a moderate intellectual disability and/or autism. Of the 21 studies, five were implemented with students with a diagnosis of ASD (Cihak, Fahrenkrog et al., 2010; Cihak, Wright, & Ayres, 2010; Gentry, Wallace, Kvarfordt, & Lynch, 2010; Mechling, Gast, & Seid, 2009; Riffel et al., 2005).

Kagohara et al. (2013) conducted a systematic review of literature of studies that involved iPods, iPads, and related devices for teaching individuals with developmental disabilities. Of the 15 studies that met criteria for inclusion in their review, 11 included interventions for individuals with ASD, with one study's being cited in Mechling's (2011) review of literature (Achmadi et al., 2012, Burke et al., 2010; Flores et al., 2012; Kagohara, Sigafoos et al., 2012; Kagohara, van der Meer et al., 2012; Kagohara et al., 2010; van der Meer, Didden et al., 2012; van der Meer et al. 2011; van der Meer, Kagohara et al., 2012; van der Meer, Sutherland et al., 2012). Through further database searches, journal searches, and review of references an additional five studies were found to implement the use of an iPad or iPod for interventions with individuals with ASD (Burton et al., 2013; Cardon, 2012; Ganz, Boles, Goodwyn, & Flores, 2014; Johnson et al., 2013; Mechling & Savidge, 2011). Table 5 shows the summary of the participants, settings, intervention, technology tool, research design, targeted domain, and results of studies implementing technology with individuals with autism (only information about participants with a diagnosis are included).

Table 5: Summary of Studies Implementing Technology with Individuals with ASD

Reference	Participants	Setting	Intervention	Tool	Design	Domain	Results
Riffel et al. (2005)	16-year-old male	School setting not specified	Picture and audio presentation	Palmtop Comp.	Multiple baseline across participants design	Living Skills	Decreased prompts to complete task
Mechling el al. (2009)	16-year-old male 17-year-old male 17-year-old male	High school home living room	Picture, audio, and video presentation	Hewlett Packard iPAQ Pocket PC	Multiple probe design across activities	Living Skills	Increased independent steps performed
Gentry et al. (2010)	22 participants >14-years-old 18 males 4 females	School setting not specified	Calendar, reminders, and alerts	Palm Zire 31 PDA	Quasi-experimental study using pre- and post-assessment design	Independent use of PDA	82% independent use of PDA Dep. T Test- statistically significant improvement in performance and satisfaction
Cihak, Wright, & Ayres (2010)	11-year-old male 11-year-old male 13-year-old male	General education class	Self-photos performing task- PPT with rotating photographs	HP iPAQ Mobile Media Companion	Multiple probe across settings with an embedded ABAB design	Task engagement	Increased task engagement and decreased teacher prompts

Reference	Participants	Setting	Intervention	Tool	Design	Domain	Results
Cihak, Fahrenkrog, Ayres, & Smith (2010)	6-year-old male 7-year-old male 7-year-old male 8-year-old male	General education class	Video-Modeling	iPod	ABAB design	Transitions	Increased independent transitions
Burke et al. (2010)	20-year-old male 20-year-old male 27-year-old male	Large, open area of a 20,000 sq foot building	Text Cues	iPod and iPhone (adult touched cue on iPhone and it displayed on iPod	Multiple baseline across participants design	Scripted behaviors performed by mascot (work skills)	Increased percentage of performed behaviors
Kagohara et al. (2010)	17-year-old male	Separate school for students with disabilities	Speech generating device	iPod Touch with Proloquo 2Go software	Case study	Communi-cation	Increased selection of preferred items/ activities
van der Meer et al. (2011)	13-year-old male	Self-contained class	Speech generating device	iPod Touch with Proloquo 2Go software	Multiple probe across participants design	Communi-cation	Increased selection of preferred items

Reference	Participants	Setting	Intervention	Tool	Design	Domain	Results
Mechling & Savidge, (2011)	14-year-old male 14-year-old female 14-year-old male	Self-contained middle school class	Pictures, audio and video presentation	The Cyrano Communi-cator with One Write Company software	Multiple probe design across activities	Task Completing and transition-ing within tasks	Increased independent task completion and transition within tasks
Kagohara, Sigafoos et al. (2012)	12-year-old male 10-year-old female	Self-contained class	Video-modeling	iPad	Multiple baseline across participants design	Academics	Increased ability to check spelling words using a computer word processor
van der Meer et al. (2012)	10-year-old male 7-year-old male	Self-contained class in public primary school	Speech-generated device	iPod Touch with Proloquo 2Go software	Multiple probe across participants design	Communi-cation	Increased selection of preferred items/ activities
Achmadi et al. (2012)	17-year-old male 13-year-old male	Separate school for students with disabilities	Speech-generated device	iPod Touch with Proloquo 2Go software	Multi-probe, multiple baseline across participants design	Communi-cation	Increased selection of preferred items/ activities

Reference	Participants	Setting	Intervention	Tool	Design	Domain	Results
Flores et al. (2012)	5 males 8-11-years old	Separate school for students with disabilities	Speech-generated device	iPad with *Pick a Word* application	Alternating treatment design	Communi-cation	3 participants made more requests with iPad 2 participants showed no difference
Kagohara, van der Meer et al. (2012)	13-year-old male 17-year-old male	Separate school for students with disabilities	Speech-generated device	iPod Touch and iPad with Proloquo 2Go software	Multiple probe across participants design	Communi-cation	Increased picture naming responses
van der Meer, Didden et al. (2012)	12-year-old male 6-year-old male 13-year-old female	Therapy room in a separate school for students with disabilities	Speech-generated device, Picture exchange, and Manual signing	iPod Touch with Proloquo 2Go software	Multiple probe across participants design	Communi-cation	Increased percentage of correct requests with iPod and Picture exchange Mixed-results

Reference	Participants	Setting	Intervention	Tool	Design	Domain	Results
van der Meer, Sutherland et al. (2012)	4-year-old male 4-year-old male 10-year-old male 11-year-old female	3- Home based and 1- self-contained class in public primary school	Speech-generated device, Picture exchange, and Manual signing	iPod Touch with Proloquo 2Go software	Alternating treatments design	Communi-cation	Increased percentage of correct requests with iPod and Picture exchange Mixed-results
Mechling & Ayers (2012)	19-year-old male 19-year-old male 21-year-old male 21-year-old make	Secluded classroom setting	Video Modeling	Hewlett Packard iPAQ (PDA) and 7.5 x 11.5" Dell Latitude D620 Laptop	Alternating treatments design	Communi-cation	Increased fine motor task completion for both conditions. Clear difference for 3 participants favoring laptop and 1 no clear difference
Mechling & Youhouse (2012)	7-year-old male 9-year-old male 11-year-old male 9-year-old make	Secluded section of the library or hallway in public school	Video Modeling	Hewlett Packard iPAQ (PDA) and 7.5 x 11.5" Dell Latitude D620 Laptop	Alternating treatments design	Communi-cation	Increased fine motor task completion for both conditions. Clear difference for 3 participants favoring PDA. No clear difference for 1 participant.

Reference	Participants	Setting	Intervention	Tool	Design	Domain	Results
Burton et al. (2013)	13-year-old male 14-year-old male 15-year-old male	Self-contained class	Video-self modeling	iPad	Multiple baseline across participants design	Academics	Increased accuracy of math calculations
Cardon (2013)	3-year-old female 4-year-old male 2-year-old make 2-year-old female	University laboratory	Video-self modeling imitation training	iMovie on iPad	Multiple baseline across participants design	Imitation Skills	Increased imitation skills
Johnson et al. (2013)	17-year-old male	Self-contained class	Video prompts	iPod Touch with Picture Scheduler Application	Multiple probe across behaviors design	Living Skills	Increased percentage of steps completed independently
Ganz et al. (2014)	8-year-old male 9-year-old female 14-year-old male	Separate classroom used for testing Quite room in home	Visual scripts	iPad with iCommuni-cate application	Alternating treatments design between treatment and non-treatment	Communi-cation	Increased spontaneous use of verbs and nouns

CHAPTER THREE: METHODOLOGY

Introduction

The purpose of this research study was to compare the impact of a Visual Activity Schedule delivered via iPad and the paper-based Visual Activity Schedule on the percentage of on-task behavior and median transition time, as measured in seconds, for students with Autism Spectrum Disorder during academic center activities in an inclusive classroom setting. This study took place in a public charter school that provides instruction for students with autism spectrum disorder in inclusive classroom settings in Orange County, Florida. Visual Activity Schedules (VAS) are tools that present an abstract concept, such as time, in a concrete and manageable form. VAS allow students to anticipate upcoming events and activities, develop an understanding of time, and facilitate the ability to predict change (Meadan et al., 2011). Prior investigations have used VAS to increase on-task behavior and assist with transition while enhancing the student's ability to independently make transitions from one activity to another. They are particularly appropriate as they capitalize on the visual strengths exhibited by many students with ASD (Banda & Grimmett, 2008; Band et al., 2009; Bryan & Gast, 2000; Dooley et al., 2001; Hall et al., 1995; Krantz et al., 1993; Massey & Wheeler, 2000). Currently, mobile devices such as the iPad are becoming tools for teaching students with disabilities, and research is underway to determine the effectiveness of specific applications on student communicative, behavioral, and academic performance. This study expands on the already-established evidence-based practice of visual activity schedules for students with autism spectrum disorder by examining how technology may influence participants' percentage of on-task behavior and duration of time transitioning between academic center activities.

Research Questions

1. Is there a difference between an iPad Visual Activity Schedule application compared to a paper-based Visual Activity Schedule for the percentage of on-task student behavior for students with Autism Spectrum Disorder during literacy center activities?
2. Is there a difference between an iPad Visual Activity Schedule application compared to a paper-based Visual Activity Schedule for the duration of transition time, as measured in seconds, for students with Autism Spectrum Disorder during literacy center activities?

Research Design

An alternating-treatment single-subject research design was used to determine whether a divergence exists between the two VAS implemented. Alternating-treatment designs are often used to compare two or three interventions and can be used to compare two variations of the same intervention (Alberto & Troutman, 2006; Gast, 2010). Alternation of treatments (the iPad VAS or the paper-based VAS) was randomly assigned, with the stipulation that there was to be no more than two consecutive observations of the same condition (Gast, 2010). Each student received either the paper-based VAS or the iPad VAS, depending on the random assignment of treatment. An alternating treatment design is appropriate for answering the research questions because it can be "used with acceleration and deceleration behaviors," such as increasing on-task behavior and decreasing transition time (Gast, 2010, p. 248).

The first research question collected data for on-task behavior using a 10-second whole-interval measure. Interval recording divides the observation period into equal intervals, and whole-interval measurement records the target behavior as present if the behavior occurred during the entire interval period (Gast, 2010). On-task behavior was defined as the participants' (a) visually attending to the appropriate scheduled materials; or (b) looking at their picture activity schedule; or (c) manipulating the appropriate scheduled materials (i.e., as they were designed to be used); or (d) looking at or attending to the adult teaching the center (Bryan & Gast, 2000; MacDuff et al., 1993; Pelios, Macduff, & Axelrod, 2003).

The second research question collected data for duration of transition time and a median score for the three transition times was recorded per observation. Duration of transition time was collected by activating a timer once a cue to transition was given and deactivating it once the participant was at the appropriate center. A minimum of three different participants is needed in order to demonstrate effect (Horne et al., 2005). Each of the two conditions, the paper-based visual activity schedule and the iPad visual activity schedule, had five observation/data collection sessions and included five baseline observation/data collection sessions (Kratochwill et al., 2013).

Participants

An initial convenience sample of three students with a primary diagnosis of autism spectrum disorder was selected. Criteria for participant selection included (a) a diagnosis of autism spectrum disorder as stated on the IEP, (b) grade level K-1, (c) receipt of instruction through language arts activity centers taught within one classroom, and (d) difficulty with independent on-task behavior as reported by the participant's teacher. The participants' IEP were reviewed to determine that criteria for participation were met. However, one participant was removed from the study by the parents and teacher due to intensive behavioral needs during baseline data collection, so only three participants were included in this study.

Along with reviewing the student participants' IEPs to determine criteria for selection, student demographic information was also collected. The primary investigator collected information on the participants' age, gender, ethnicity, domains of annual goals, and exceptional student education services from the students' current IEP. Since this study took place during reading activities, data on the participants' reading level were collected from the participants' Florida Assessments for Instruction in Reading (FAIR) scores. The FAIR is a comprehensive assessment system that evaluates students' ability levels in the area of reading and is administered three times a year for students in kindergarten through high school (Florida Department of Education FL-DOE, 2009). Student in kindergarten through second grade are assessed in the areas of phonemic awareness, phonics, fluency, vocabulary, text comprehension, and orthographic skills (spelling).

Setting

The setting for this study was a kindergarten–first grade inclusive classroom at a public charter school in the Orange County Public School District. Participants received reading instruction in an inclusive classroom environment. The classroom had nineteen students: eight males and eleven females. Six of the nineteen students had been diagnosed with a disability and had an IEP. Four students received special education services for ASD, one student for other health impairment (OHI), and one student for speech and language impairment (SPL). The study took place during a language arts block of 90 minutes during the morning session of the school day. The first 30 minutes of the language arts block was a whole-group reading instruction and was followed by four 15-minute small-group literacy activity centers.

During the 90-minute reading block the whole class began at the whole-group circle time center and then transitioned to the four small-group centers as designated by their small-group rotation schedule. The duration for each literacy center was an average of 15 minutes. All literacy centers were located within the same classroom and included a guided reading center, phonics center, computer center, and independent reading center. The classroom teacher organized the students into four groups, with four-to-six students in each group, prior to the implementation of the study. All participants included in this study were in different small groups and had a different literacy center rotation schedule.

Literacy center areas had clearly defined boundaries within the classroom. The guided reading center was facilitated by the general education teacher, and the phonics center was facilitated by the special education teacher or the classroom paraprofessional. The computer center and the independent reading center were independent activities, with the paraprofessional providing guidance to students when needed. Lesson plans for guided reading and phonics are located in appendixes C and D. Lessons for the guided reading centers were designed around the current classroom language arts curriculum. Lesson for the phonics center included language arts activities from the Florida Center for Reading Research (FCRR) (fcrr.org). At the computer center, participants completed activities from the website Starfall.com. The independent reading center housed a bucket of leveled books that focused on the whole-group instructional lesson (winter, sequencing, and cause and effect). Each literacy center followed the same lesson plan for all four small groups.

Time Line

This study was launched in October of 2013 and began with the selection of participants and obtaining the consent forms. Baseline data were collected between October 28 and November 6, 2013. All participants began the intervention phase on November 7, 2013, and completed the intervention phase on November 21, 2014. The videotaping procedure occurred throughout the baseline and intervention phases and was completed on November 29, 2013. Data collection by independent observers began on December 2, 2013, and was completed by January 10, 2014.

Dependent Variables

On-task was defined as the participants' (a) visually attending to the appropriate scheduled materials; or (b) looking at their picture activity schedule; or (c) manipulating the appropriate scheduled materials (i.e., as they were designed to be used); or (d) looking at or attending to the adult teaching the center (Bryan & Gast, 2000; MacDuff et al., 1993; Pelios, Macduff, & Axelrod, 2003).

Transition time was defined as the total time it took for the students to transition from one academic center to the next academic center on their visual activity schedule when given a signal to transition. The timer began when the cue to transition was given, which was designated by the sound of the teacher timer, and concluded when the student was in the academic center area and engaging in on-task behavior for that activity center. Transition time was recorded for all three transitions between small-group literacy centers, and a median transition time was reported for data analysis.

Independent Variable

The independent variables for this study included a VAS delivered via iPad and a paper-based VAS. Activity centers for both the paper-based VAS and the iPad VAS had identical visual and textual representations.

Paper-based, visual activity schedule. The paper-based VAS is a 9.5" x 7" paper-based, visual activity schedule with visual representations of each literacy center activity in a vertical format along the left side of the schedule. The visual activity schedule includes two columns with "first I need to" on the left and "All done" on the right. The visual activity schedule base and literacy activity visuals were laminated. Velcro was used to stick the literacy activities on the activity schedule base and move the literacy activities from the "first I need to" to the "All done" column. A choice reinforcer option was provided at the bottom of the VAS. The literacy center visuals were 1" x 1" colored drawings of the activity with the center activity names in text (see Appendix A).

The Choiceworks™ visual support system. The Choiceworks™ Visual Support System application is an individual VAS created and owned by Bee Visual™ LLC. This VAS mirrors the paper-based visual schedule in relative size and colors, visual and textual representations, and organization of scheduled activities. The Choiceworks™ Visual Support System application not only allows for visual representation and order of scheduled activities, but includes a timer that counts down the time for each center activity. A choice reinforcer option is provided at the bottom of the VAS (see Appendix B).

Procedures

Consent

Permission from Bee Visual™, the creators of the Choiceworks™ application, for the use of the Choiceworks™ was obtained via email for use in this dissertation study. Following permission from the creator of the application, approval for research with human participants was obtained through the university through the Institutional Review Board (IRB) (see Appendix E). Approval was also obtained via written consent from school administration through the public charter school where the study took place. Parent/guardian permission was obtained through the adult consent form and child participation was obtained through verbal agreement. Once all permissions were obtained the researcher began instruction of the interventions with the participants.

Instruction

VAS Instruction for Participants

A protocol for introducing both the iPad visual activity schedule and the paper-based visual activity schedule was designed and implemented with each student participant. Student participants were considered able to independently use the visual schedules when they were able to correctly manipulate the VAS with 100% accuracy on two out of three trials, based on the scripts used to introduce the intervention (see Appendix F and Appendix G). The week before the intervention the researcher followed the script with each participant until mastery was reached. The script provided an explanation for how the VAS are used and the participants physically manipulated the VAS during instruction. Instruction of the VAS was recorded, and independent data collectors reviewed the video to ensure that fidelity of implementation was met.

Prior to collecting baseline data the general education teacher provided the participants with a menu of reinforcing conditions that included Hershey Kisses, Skittles, M&Ms, and Starbursts. Participants chose their two preferred reinforcers before the primary investigator began the instruction on the VAS. The chosen two reinforcers were included on both VAS and were represented with a visual and textual representation. Reinforcers were provided following the conclusion of the 90-minute reading block when the participants completed all four reading centers, as determined by the adult facilitating the activities. The participants either selected the reinforcer from the choices on the iPad by touching the visual (it enlarges) or by selecting the laminated line drawings on their paper-based VAS and handing it to their general education teacher.

VAS Instruction for Teachers

Teachers were provided with information regarding the purpose of the study through a letter, but information on dependent variables was removed (see Appendix H). Teachers understood that the researcher was looking for differences in student behavior based on the two different visual activity schedules, but specific student behaviors were not divulged in order to prevent potential influence in student behaviors from teachers. The letter informed the teachers that the VAS were to be used as independent tools by the students, and teachers were asked not to prompt or direct the student to use the VAS.

Data Collection Training

A sample classroom video was recorded prior to collecting baseline data for training purposes of independent data collectors. A protocol was designed to train data collectors on the implementation of whole-interval data collection and exact duration of transition (see Appendix I). Independent data collectors reviewed ten-minute sample classroom videos and collected data on on-task behavior using a 10-second whole-interval procedure. They collected data on transition time using a stopwatch to record duration of transition time. After each sample the primary investigator calculated IOA. Interobserver agreement (IOA) for training of observers was at least 80% on two out of three trials before beginning data collection during the study.

Baseline

Baseline data were collected for five observational periods. Often, baseline is not included in alternating treatment designs (Gay & Airasian, 2000). However, the primary investigator included a baseline phase to strengthen the study and analysis of data. During baseline, participants participated in their literacy center activities without the implementation of the independent variable. Baseline data were collected for on-task behavior using a 10-second whole-interval procedure during the four small-group centers. Baseline data were also collected on the duration of transition time during the three transitions between small-group activities.

Intervention

Each student was randomly assigned to one of the two conditions per observation prior to each observation. Treatments were randomly assigned by drawing to each condition out of a cup filled with five iPad VAS treatments and five paper-based VAS treatments (e.g., ABBABAABAB). Alternations of treatments were randomly selected, with the stipulation that there was to be no more than two consecutive observations of the same condition (Gast, 2010; Kratochwill et al., 2013). If more than two consecutive observations of the same condition occurred (e.g., ABB**AAA**BABB), the primary investigator replaced all treatment options and a new random assignment order was selected. Each participant had an individualized treatment condition schedule through random selection of treatments for each participant in order to minimize a counterbalance effect. Students and teachers were not aware of the order of treatment conditions until the beginning of each observation session. Table 6 provides the order of treatment conditions for each participant. To ensure that fidelity of treatment was met a task analysis was created of the steps for implementing the paper-based VAS and iPad VAS (see Appendix J and Appendix K). Data collectors reviewed videos and recorded whether each step occurred during observation sessions.

Table 6: Alternating Treatment Schedule

Observation session	Student 1	Student 2	Student 3
1	iPad VAS	Paper VAS	Paper VAS
2	iPad VAS	iPad VAS	iPad VAS
3	Paper VAS	Paper VAS	iPad VAS
4	iPad VAS	Paper VAS	Paper VAS
5	Paper VAS	iPad VAS	Paper VAS
6	Paper VAS	iPad VAS	iPad VAS
7	iPad VAS	Paper VAS	Paper VAS
8	Paper VAS	Paper VAS	Paper VAS
9	iPad VAS	iPad VAS	iPad VAS
10	Paper VAS	iPad VAS	iPad VAS

Implementation of the visual activity schedules and recording of student behavior began at the beginning of the 60-minute small-group literacy center block. Students were provided with either the iPad visual activity schedule or the paper-based visual activity schedule upon leaving the whole-group literacy instruction circle time. Participants independently used the VAS as they participated and transitioned through the language arts literacy centers. Upon completion of all four literacy centers the participants were provided with the choice reinforcer.

Video Taping Procedure

Two digital video recorders were used to create a permanent product of the interventions. Permanent products have the advantage of yielding "precise records of student behavior that can be stored later for comparison" (Gast, 2010, p. 139). The digital video recorders were placed in two locations in the room, on tripods, in order to have a vantage point for all literacy center activities. The primary investigator monitored the digital video recorders during literacy center activities to ensure that participants were in view of the camera. The recordings included both audio and video of the entire small-group literacy center activity block. The digital videos were then uploaded onto the primary investigator's computer and deleted from the digital recorders. The two videos from each observational session were then imported into Windows Movie Maker for editing. The primary investigator edited the two videos by splitting and combining clips to create one video for each participant that showed the best focal point of that participant at each literacy center. Video editing was completed for all observations for each participant, yielding a total of 15 video recordings for each participant and 45 video recordings total. Once the video editing was completed, an audio file of the 10-second interval cues were added.

The primary investigator created an audio file of a 10-second interval stopwatch to cue the data collectors when to record on-task behavior data. The audio files were created using the sound-recorder application on a Hewlett-Packard computer and the loop countdown timer from www.online-stopwatch.com. The audio file was then added to the video recordings using the add music function. The complete videos were then saved as an MP4 file to allow for viewing on a PC or MAC computer. Finally, the MP4 files were transferred onto an external hard drive for portability and deleted from the primary investigator's computer.

Materials

Paper-based, visual activity schedule. The paper-based VAS is a 9.5" x 7" paper-based visual activity schedule with visual representations of literacy center activities in a vertical format along the left side of the schedule. The literacy center visuals were 1" x 1" and included a colored drawing of the activity and center activity names in text. The title of the visual schedule was presented at the top and had a visual and textual representation. The visual activity schedule included two columns with "first I need to" on the left and "All done" on the right. Each literacy activity was placed under the "first I need to" column in a top-to-bottom sequential order. The visual activity schedule base and literacy activity visuals were laminated. Velcro was used to stick the literacy activities on the activity schedule base and to enable students to move the literacy activities from the "first I need to" to the "All done" column. The student was to move the completed activity to the all done column once the teacher timer sounded and the adult facilitating the center agreed that the student had completed the activity. This process was repeated for each activity until the reading block ended. A choice reinforcer option was provided at the bottom of the VAS. The reinforcer was chosen by the participant and provided to the participant following completion of the four literacy centers.

The Choiceworks™ visual support system. The Choiceworks™ Visual Support System app is an individual visual activity schedule creator and is owned by Bee Visual™ LLC. The visual support system app was downloaded and accessed on an iPad 2. This visual activity schedule mirrored the paper-based visual schedule in relative size and colors, visual and textual representations, and organization of scheduled activities. The Choiceworks™ Visual Support System app not only allows for visual representation and order of scheduled activities, but a timer is included as part of the application for each activity and it counts down the time for each center activity. Activity timers can be set by the minute up to 60 minutes. Students first touched the activity that they were to do. They then touched the timer to begin the countdown. When the timer reached zero a sound was given. Following the signal that the activity time had ended, as designated by the teacher timer, the student moved the activity to the all-done column. The student then repeated those same steps for each activity until the reading block concluded. A choice reinforcer option was provided at the bottom of the VAS. The reinforcer was chosen by the participant and provided to the participant following completion of the four literacy centers.

iPad 2. The iPad is a tablet computer that is designed and marketed by Apple Inc. This product runs the Apple iOS operating system. The iPad is a touchscreen device that includes a virtual keyboard and color display and has built-in Wi-Fi for internet access. The iPad has the capability of taking video and photos, web browsing and e-mail, playing music, and the ability to download and install apps. The iPad 2 has a height of 9.5 inches, a width of 7.31 inches, a depth of .34 inches, and a weight of 1.33 pounds (http://www.apple.com).

Digital Video Recorder. Two digital video recorders were used to create a permanent product of the interventions. One digital video recorder used was the Canon VIXIA HF 20. The second digital video recorder was the Sony HANDYCAM HDR-CX230. Both video recorders had Full HD 1080 capabilities and can hold up to 80 minutes of consecutive video recording.

Hard Drive. A My Passport hard drive with 500 GB of memory was used to store password-protected videos for data analysis. The hard drive was password protected and was stored in a locked cabinet in the primary investigator’s locked office. Data collectors retrieved the hard drive from and returned the hard drive to the primary investigator prior to and ending each data collection session in order to maintain the security of the videos.

Stopwatch. A CE brand stopwatch was used to collect the duration data and provide the exact minute and second for the time it took students to complete the transitions. The CE stopwatch includes a 1/100 second precision, calendar and time, daily alarm, and a large digital display.

Data Collection Procedures

Data collection of on-task behavior began once students were seated and began working at their small-group literacy centers. Duration of transition time was collected for all three transitions between small-group activity centers. Data were not collected during the whole-group reading center and the transition of the whole class to the first small-group center. Data were not collected during the whole-group center and whole-group transition as these are different settings with different expectations from the four small-group centers and the three transitions between small groups. Therefore, data collection began once students were seated at and engaged in on-task behavior at their first small-group literacy center. On-task behavior was recorded throughout the four small-group literacy centers. A minimum of five observations per condition were implemented in this study. Therefore each participant had the opportunity to use each VAS for one entire reading block five different times.

A 10-second whole-interval procedure was used as the primary dependent measure of on-task behavior, and a percentage of on-task behavior was calculated for each observation. Due to the potential variance of opportunity for on-task behavior to occur in the natural classroom environment, the researcher chose an interval-recording data-collection method to measure per opportunity for on-task behavior. Interval recording divides the observation period into equal intervals and records the occurrence or non-occurrence of the target behavior during each interval (Gast, 2010). Gast (2010) stated that whole-interval recording is "well suited to collect data on behaviors of long duration that are difficult to measure," such as on-task behavior (p. 144). Gast (2010) suggested that while measuring duration per occurrence would be ideal for evaluating on-task behavior, whole-interval recording "may be more practical and can provide an estimate of total duration" (p. 144).

Duration recording was used to record the dependent variable of transition time. Data on duration of transition time were collected for the transitions between the four small-group literacy centers. A timer was started once the cue to transition was given to the whole class, as designated by the teacher timer, and stopped once the participant was at the appropriate center and engaging in on-task behavior for activity. A median transition time was reported for data analysis instead of mean in order to avoid regression to the mean.

Observations by a second observer were completed for 40% of all observations (four out of 10 sessions), with 40% for each condition (two out of five sessions), to ensure accuracy with data collection. IOA was calculated using the point-by-point calculation (i.e., agreements/(agreements + disagreements) X 100) (Gast, 2010) with a minimum of 80% agreement required (Kratochwill et al., 2013). Data collectors were trained prior to viewing the video of observations to ensure accuracy of data collection.

Data Analysis

Data analysis for this study used visual analysis to compare percentage of on-task behavior and median transition time of participants during the iPad visual activity schedule segments and the paper-based visual activity schedule segments. Visual analysis was used to draw a conclusion whether one intervention is more effective than the other by looking at a divergence of data to determine whether a clear difference exists (Gast, 2010). Data on percentage of on-task time and for median transition time were graphed using Microsoft Excel, and visual analysis was used to determine whether there was a divergence in results between conditions. Data results and discussion are presented in the following chapters of this manuscript and were presented to student participants, parents/guardians, teachers, and school administration.

Calculation of percentage of non-overlapping data (PND) was also used to compare each condition being alternated against the other and to compare baseline to each treatment condition. PND for alternating treatment designs looks at consistent differences between data-point values of the two conditions that are alternated during the comparison phase (Gast, 2010). To calculate PND for alternating treatment designs compare each condition being alternated against each other by comparing the first data point for the iPad VAS to the first data point for the paper-based VAS, compare the second data point for the iPad VAS to the second data point for the paper-based VAS, and so on (Richards, Taylor, & Ramasamy, 2014). PND for comparison between baseline and each treatment condition was calculated using the procedure described by Gast (2010) and included (a) finding the range of the first condition, (b) counting the data points in the second condition, (c) counting the data points in the second condition that fall outside of the range in the first condition, (d) dividing the number of data points that fall outside the range of the first condition by the total number of data points in the second condition, and (e) multiplying that number by 100 (p. 215).

Fidelity of Treatment

Introduction of the specific VAS for the day was evaluated to determine the fidelity of treatment. A task analysis of the steps for introducing the VAS to each student was created, and independent data collectors recorded a "yes" or "no" if the primary investigator followed each step (see Appendixes J and K). One data collector reviewed all ten treatment videos and the second data collector reviewed 40% of all treatment videos that included 40% of observations for each treatment condition (two observations for the iPad VAS and two observations for the paper-based VAS). IOA was calculated using the point-by-point calculation (i.e., agreements/(agreements + disagreements) X 100; Gast, 2010) with a minimum of 80% agreement required (Kratochwill et al., 2013).

Instruction of the VAS provided to participants was recorded, and independent data collectors reviewed video to ensure that fidelity of implementation was met. A task analysis of the scripts for introducing VAS was created to determine whether each step of the protocol was followed. One independent data collector reviewed all instructional videos and recorded a "yes" or "no" if the primary investigator followed each step in the protocol. The second independent data collector reviewed 33% of instructional videos and also recorded whether each step in the protocol was followed. IOA was calculated using the point-by-point calculation with a minimum of 80% agreement required.

Reliability

All observation sessions were recorded to create a permanent product of the study to increase reliability. Analysis of percentage of on-task behavior and median duration of transitions were collected by two outside observers who viewed the video of the interventions. The independent observers were trained prior to collecting data with an interobserver agreement (IOA) of at least 80% for both on-task behavior and transition time. One independent observer collected data on all 15 observations (five baseline and ten treatment conditions) for each of the three participants. The second independent observer collected data for 40% of all observations (6 out of 15 sessions), with 40% for each condition (2 out of 5 sessions for baseline, iPad VAS, and paper-based VAS), for each participant, to ensure accuracy and reliability of data collection. Interobserver agreement (IOA) was calculated using the point-by-point calculation (i.e., agreements/ (agreements + disagreements) X 100; Gast, 2010) with a minimum of 80% agreement required (Kratochwill et al., 2013). For on-task behavior an agreement was defined as both observers' recording the same behavior code. For duration of transition time agreement was defined as both observers' recording a transition time within five seconds of each other.

Validity

The use of alternating treatment designs guards against many threats to internal validity due to the relatively short time frame of the study (Gast, 2010). The short durations of alternating treatment design studies have minimal threats to maturation and history validity issues. Additionally, threats to extra-experimental events would typically influence performance under both conditions (Gast, 2010).

Alternating treatment designs are subject to multi-treatment interference or carryover effects and sequential confounding effects. To minimize multi-treatment interference or carryover effects only one condition was implemented per day (Gast, 2010). To control for sequential confounding effects this study implemented conditions through a random assignment of conditions, with no more than two consecutive sessions of the same condition.

Social Validity

Social validity data were collected following the intervention for both the participants and teachers in this study. Teachers in the study completed the Intervention Rating Profile 15 (IRP-15) social validity questionnaire on the use of the iPad VAS for each individual participant. The IRP-15 assesses the acceptability of an intervention with an internal consistency of .98 and validity from principal component analysis resulting in a unitary factor (Carter, 2007). All items are answered using a 6-point Likert scale, with 1 for *Strongly Disagree* and 6 for *Strongly Agree*. The IRP-15 was completed by the general education teacher, the special education teacher, the speech and language pathologist, and the special education paraprofessional. Participants were given a preference assessment for both the iPad VAS and the paper-based VAS and asked why they preferred their choice.

CHAPTER FOUR: RESULTS

Introduction

The purpose of this study was to examine the impact of VAS delivered via the iPad, compared to a paper-based VAS, on the percentage of on-task behavior and median transition time for students with autism spectrum disorder (ASD) during academic center activities in an inclusive classroom setting. An alternating-treatment single-subject research design was used to determine whether a divergence exists between the paper-based VAS and the iPad VAS. The study concluded in November of 2013 with three of the four originally identified participants. Unfortunately, one participant was removed from the study by the parents and general education teacher due to severe behavioral concerns and participated only in baseline data collection for three observational sessions. This participant was not only removed from the study but was placed in a different K-1 classroom that provided more intense supports based on student needs. Therefore, three participants were included in this study, and results are presented for each participant. A review of results is presented in the following focal areas: participant demographics, data collection, inter-rater reliability, fidelity of treatment, statistical analysis, treatment outcomes, and social validity.

Participant Demographics

Three elementary students who attended a public charter school in the Orange County Public School District were selected to participate in this study. The participants received reading instruction in an inclusive classroom environment in which 42% students were males, 58% were females, 32% had a diagnosed disability, and 68% were students without disabilities. Identified study participants all had a diagnosis of ASD, were in grade level K-1, received instruction through language arts activity centers taught within the same classroom, and had difficulty with independent on-task behavior as reported by the their teacher. Table 7 provides a listing of each participant's birth date, sex, race, special education label, domains of annual goals, and FAIR scores.

Table 7: Participant Profiles

Student	Age	Sex	Race	Special education label	Domains of annual goals	FAIR scores
1	5 years 6 month	Male	Hispanic	ASD OT PT	Curriculum and Learning Independent Functioning Communication Social/Emotional Behavior	PRS- 93% VPR- 47th
2	7 years 2 months	Male	Caucasian	ASD LI SI OT	Curriculum and Learning Independent Functioning Communication Social/Emotional Behavior	PRS- 66% VPR- 29th
3	6 years 10 months	Female	Caucasian	ASD LI OT	Curriculum and Learning Independent Functioning Communication Social/Emotional Behavior	PRS- 56% VPR- 59th

Special education label = diagnosis of disability as stated on the individualized education plan. ASD = Autism Spectrum Disorder. OT = Occupational Therapy. PT = Physical Therapy. LI = Language Impairment. SI = Speech Impairment. FAIR Scores= Florida Assessments for Instruction in Reading assessment period one. PRS = Probability of Reading Success. VPR = Vocabulary Percentile Rank.

Student 1, a Hispanic male, was assigned to the kindergarten grade level. His original diagnosis took place in New York and this was his first year attending the public charter school. According to his IEP he has difficulty with relating to others, following directions, and staying on task. The IEP also states that he requires verbal repetitions, visual cues, and modeling to assist him with maintaining focus and attending to the task at hand.

Student 2, a Caucasian male, was assigned to the first grade level. According to his IEP he has difficulty initiating and interacting with his peers. Additionally, he has difficulty attending to the task at hand and needs teacher support to redirect him to attend to and complete academic tasks. The IEP also states that he needs a structured, predictable routine with small breaks throughout the day and requires small-group, direct, specialized instruction in order to be successful.

Student 3, a Caucasian female, was assigned to the first grade. Her IEP states that she has difficulty with independent functioning, self-regulatory behavior, and socialization skills. Additionally she requires organizational strategies or supports to complete academic tasks and small-group, specialized instruction in self-regulatory behavior and socialization skills. Instructional accommodations include the use of time management tools such as checklists, assignment planners, or visual schedules.

Data Collection

One data collection form was used to record percentage of on-task behavior and duration of transition time for each observation session for each participant. Coding for on-task behavior included an X for on-task, O for off-task, T for transition, and a slash symbol (/) if there was an obstruction of view of the student. Percentage of on-task behavior was calculated by dividing the number of on-task occurrences, as designated by Xs, by the number of total opportunities to observe and then multiplying by 100 (on-task occurrences / number of opportunities X 100). Duration of transition time was recorded, in seconds, along the bottom of the data collection form for the three transitions between literacy center activities. A median transition score was reported for each observation session, for each participant, for data analysis. The data collection form also included operational definitions for on-task behavior and transition time. The data collection form is included in the appendixes for further reference (see Appendix L).

Inter-rater Reliability

Observers included two doctoral graduate research assistants. Prior to data collection, the two observers met with the primary investigator for data collection training. The primary investigator followed the data collection training protocol, which included reviewing the operational definitions for on-task behavior and transition time, standards for data collection, and specified observational procedures (see Appendix I). During the data collection training the two observers watched three 10-minute clips from sample classroom videos to practice observation and recording procedures. After each 10-minute clip the primary investigator calculated inter-observer agreement (IOA) for on-task behavior using the point-by-point calculation (i.e., agreements/ (agreements + disagreements) X 100; Gast, 2010) and a minimum of 80% agreement was obtained on two of the three video clips (Kratochwill et al., 2013). The primary investigator also calculated IOA for transition time using the point-by-point calculation. For duration of transition time, agreement was defined as both observers' having a transition time within five seconds of each other.

One independent observer collected data on all 15 observations (five baseline and ten treatment conditions) for each of the three participants. The second independent observer collected data for 40% of all observations (6 out of 15 sessions), with 40% for each condition (2 out of 5 sessions for baseline, iPad VAS, and paper-based VAS), for each participant, to ensure accuracy and reliability of data collection. Table 8 provides inter-rater reliability between the two independent observers for on-task behavior and transition time.

Table 8: Overall Percentage of Inter-rater Reliability

Observation session	Dependent variable	Student 1	Student 2	Student 3
Baseline	On-Task	81	83	89
Baseline	On-Task	80	83	80
Paper VAS	On-Task	80	81	85
Paper VAS	On-Task	85	80	88
iPad VAS	On-Task	83	85	88
iPad VAS	On-Task	85	91	83
Overall sessions	Transition time	81	93	80

Fidelity of Treatment

Training on using the paper-based VAS and iPad VAS was provided to participants prior to collecting baseline data. Training on using the VAS was recorded, and independent data collectors reviewed videos to ensure that fidelity of implementation was met. Scripts for introducing the paper-based VAS and the iPad VAS can be found in Appendixes F and G. A task analysis of the scripts for introducing VAS was created to determine whether each step of the protocol was followed; the task analysis can be found in Appendixes M and N. The primary investigator implemented the VAS instruction with the participants. Each participant needed only three instructional sessions before being able to use both VAS independently. One independent data collector reviewed all nine instructional videos and recorded a "yes" or "no" if the primary investigator followed each step in the protocol. The second independent data collector reviewed 33% of instructional videos, resulting in three videos, and also recorded whether each step in the protocol was followed. IOA was calculated using the point-by-point calculation with a minimum of 80% agreement required. The primary investigator did not deviate from the script, and 100% IOA was obtained for all three instructional session.

Daily introduction of the VAS to the student was also evaluated to determine the fidelity of treatment. A task analysis of the steps for when and how to introduce the VAS to each student was created and can be found in Appendixes J and K. Independent data collectors recorded a "yes" or "no" if the primary investigator followed each step. One independent data collector reviewed all ten treatment videos, which included five observations of implementation of the iPad VAS and five observations of implementation of the paper-based VAS. The second data collector reviewed 40% of all treatment videos that included 40% of observations for each treatment condition (two observations for the iPad VAS and two observations for the paper-based VAS). IOA was calculated using the point-by-point calculation (i.e., agreements/ (agreements + disagreements) X 100; Gast, 2010) with a minimum of 80% agreement required (Kratochwill et al., 2013). Implementation of both VAS did not deviate from the steps described in the task analysis, and 100% IOA was obtained for all four intervention sessions.

Data Analysis

Data analysis for this study used visual analysis to compare percentage of on-task behavior and median transition time of participants using the iPad visual activity schedule versus the paper-based visual activity schedule. Calculation of percentage of non-overlapping data (PND) was also used to compare each condition being alternated against the other and to determine whether the data were ambiguous or unambiguous. The first data-point for the iPad VAS was compared to the first data-point for the paper-based visual activity schedule, the second data-point for iPad VAS was compared to the second data-point for the paper-based visual activity schedule, and so on (Richards et al., 2014).

Treatment Outcomes

Research Question 1

Was there a difference between an iPad VAS application compared to a paper-based Visual Activity Schedule for the percentage of on-task student behavior for students with Autism Spectrum Disorder during literacy center activities? One of the four original participants selected for this study was removed due to severe behaviors. Therefore, Figures 1, 2, and 3 provide a visual representation of the results for the three participants included in this study. Visual analysis of data is discussed and information on the level, variance, and trend of data during each condition for each participant is reported. Using the procedure described by Richards et al. (2014), the PND was calculated to determine whether there was a difference between data in the paper-based VAS condition compared to the iPad VAS condition. Effect size is presented using the Percentage of Non-Overlapping Data (PND) for comparing the paper-based VAS and the iPad VAS to baseline data for each participant using the procedure described by Gast (2010).

Visual analysis of data for on-task behavior for all three participants was completed. Based on the visual representations, all three participants had a stable baseline over the five observational sessions. Baseline data were determined to be stable when 80% of the data fell within 20% of the median. For Student 1 there was a divergence between percentage of on-task behavior, with the paper-based VAS being a superior treatment condition to the iPad VAS 80% of the time. Student 2 had a divergence between percentage of on-task behavior, with the iPad VAS being a superior treatment condition to the paper-based VAS 80% of the time. Student 3 had no clear divergence in percentage of on-task behavior between the iPad VAS and the paper-based VAS.

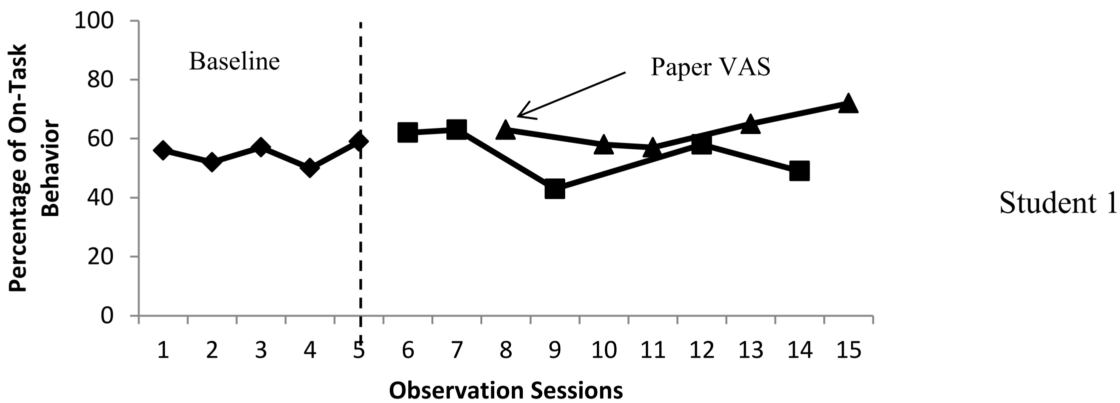


Figure 1: Student 1 Results for Research Question 1- Dependent Variable On-Task Behavior

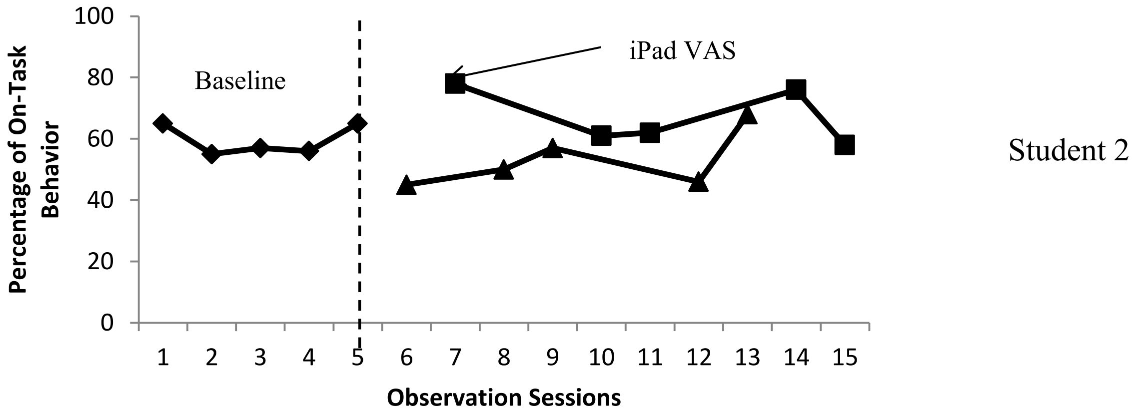


Figure 2: Student 2 Results for Research Question 1- Dependent Variable On-Task Behavior

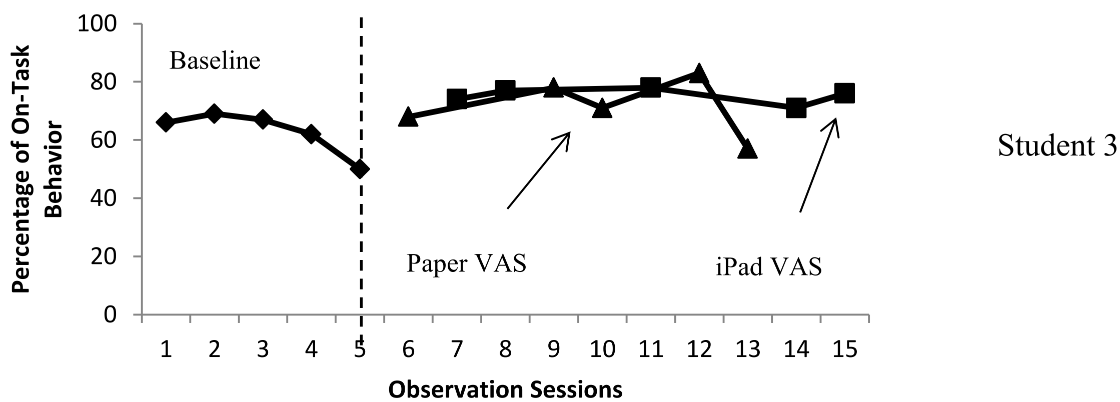


Figure 3: Student 3 Results for Research Question 1- Dependent Variable On-Task Behavior

Student 1 had a median of 56% on-task behavior during baseline data with minimal variance in the data points. During baseline 100% of the data points fell within 20% of the median (Kratochwill, 2010), showing stability in the level and variance of data. Baseline data had a range of 9% with an absolute change level of 3% in an accelerating trend direction (Gast, 2010). When the paper-based VAS was implemented Student 1 had a median of 63% on-task behavior and a level stability of 100%. The range of on-task behavior while implementing the paper-based VAS was 15% and the absolute change in level was 9% in an accelerating trend direction. When the iPad VAS was implemented Student 1 had a median of 58% on-task behavior and a level stability of 80%. The range of on-task behavior, while implementing the iPad VAS, was 20% and the absolute change in level was 13% in a decelerating trend direction.

Using the procedure described by Richards et al. (2014), the PND was calculated to determine whether there was a difference between data in the paper-based VAS condition compared to the iPad VAS condition. For Student 1 there was a divergence between percentage of on-task behavior, with the paper-based VAS being a superior treatment condition to the iPad VAS 80% of the time. The PND was calculated using the procedure described by Gast (2010). The PND between baseline and the paper-based VAS for Student 1 was 60%, showing a medium effect size. The PND between baseline and the iPad VAS was only 40%, showing a low effect size.

Student 2 had a median of 57% on-task behavior during baseline data with minimal variance in data points. During baseline the level of stability of data was 100%. Baseline data had a range of 10% with an absolute change level of 0%, showing a zero-accelerating trend. When the paper-based VAS was implemented, Student 2 had a median of 50% on-task behavior and a level stability of 80%. The range of on-task behavior, while implementing the paper-based

VAS, was 18% and the absolute change in level was 23% in an accelerating trend direction. When the iPad VAS was implemented, Student 2 had a median of 62% on-task behavior although the level of stability was only at 60%. The range of on-task behavior while implementing the iPad VAS was 20%, and the absolute change in level was 20% in a decelerating trend direction. The PND between the paper-based VAS and the iPad VAS showed a divergence in percentage of on-task behavior, with the iPad VAS being a superior treatment condition to the paper-based VAS 80% of the time. The PND between baseline and the paper-based VAS for Student 2 was 20%, showing a low effect size. The PND between baseline and the iPad VAS was 40%, also showing a low effect size.

Student 3 had a median of 66% on-task behavior during baseline data with minimal variance in data points. During baseline the level of stability of data was 80%. Baseline data had a range of 19% with an absolute change level of 16%, showing a decelerating trend. When the paper-based VAS was implemented, Student 3 had a median of 71% on-task behavior and a level stability of 100%. The range of on-task behavior while implementing the paper-based VAS was 26%, and the absolute change in level was 9% in a decelerating trend direction. When the iPad VAS was implemented, Student 3 had a median of 76% on-task behavior and a level of stability at 100%. The range of on-task behavior while implementing the iPad VAS was 7%, and the absolute change in level was 2% in an accelerating trend direction. When calculating the PND for on-task behavior between the paper-based VAS and the iPad VAS there was no clear divergence. The PND between baseline and the paper-based VAS for Student 3 was 60%, showing a medium effect size. The PND between baseline and the iPad VAS was 100%, showing a high effect size.

Research Question 2

Was there a difference between an iPad VAS application compared to a paper-based, Visual Activity Schedule for the duration of transition time, as measured in seconds, for students with Autism Spectrum Disorder during literacy center activities? One of the four participants selected for this study was removed due to severe behaviors. Therefore, Figures 4, 5, and 6 provide a visual representation of the results for the three participants included in this study. Visual analysis of data is discussed and information on the level, variance, and trend of data during each condition for each participant is reported. Using the procedure described by Richards et al. (2014), the PND was calculated to determine whether there was a difference among data in the paper-based VAS condition compared to the iPad VAS condition. Effect size is presented using the Percentage of Non-Overlapping Data (PND) for both the paper-based VAS and the iPad VAS for each participant.

Visual analysis of data for on-task behavior for all three participants was completed. Based on the visual representations, all three participants' baseline and intervention data were highly variable, with a level stability range of 20-60%. Stability range is the percent of the data that falls within 80% of the median score for that condition (Gast, 2010). Although baseline data were not stable for transition time, they were stable for on-task behavior. Due to the stability of baseline data for on-task behavior, the intervention was implemented after five data-collection sessions, even though transition time was unstable. Student 1 and Student 3 had no clear difference in transition time when comparing the paper-based VAS to the iPad VAS. Student 2 had a divergence in transition time data between the iPad VAS and the paper-based VAS, with the paper-based VAS being a superior treatment condition 90% of the time. Student 2 did have a clear divergence in VAS for the first six observation sessions of the treatment condition (100% PND), but data converged on observation sessions seven through ten.

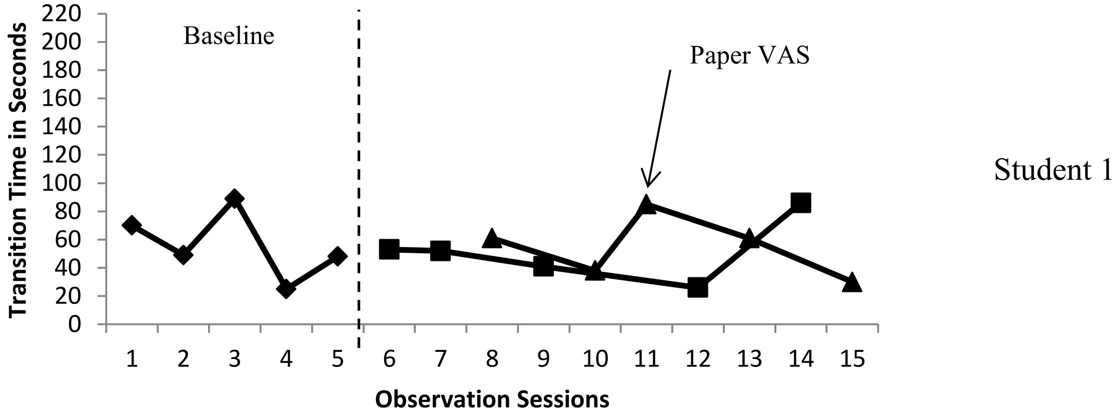


Figure 4: Student 1 Results for Research Question 2- Dependent Variable Transition Time

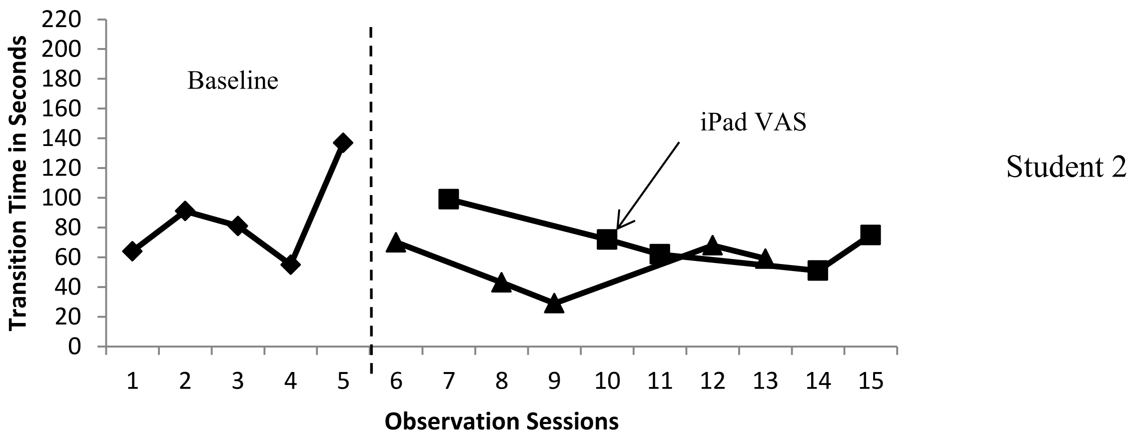


Figure 5: Student 2 Results for Research Question 2- Dependent Variable Transition Time

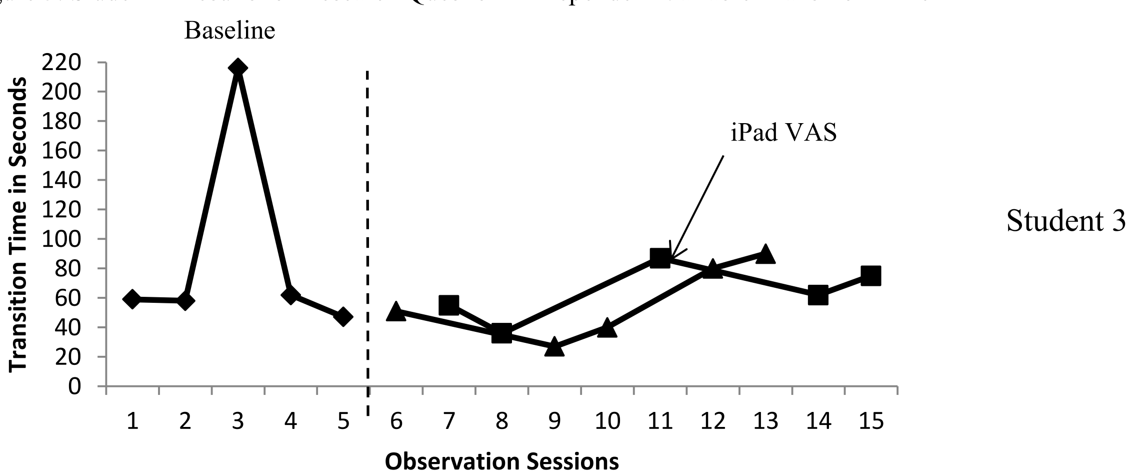


Figure 6: Student 3 Results for Research Question 2- Dependent Variable Transition Time

Student 1 had a median of 49 seconds for transition time during baseline data. During baseline only 40% of the data points fell within 20% of the median, showing a high level of variance within the data. Baseline data had a range of 64 seconds, with an absolute change level of 22 seconds in decelerating trend direction. When the paper-based VAS was implemented Student 1 had a median of 61 seconds for transition time and a level stability of 40%. The range of transition time while implementing the paper-based VAS was 55 seconds, and the absolute change in level was 31 seconds in a decelerating trend direction. When the iPad VAS was implemented, Student 1 had a median of 52 seconds for transition time and a level stability of 60%. The range of transition time while implementing the iPad VAS was 60 seconds, and the absolute change in level was 33 seconds in an accelerating trend direction.

Using the procedure described by Richards et al. (2014) the PND was calculated to determine whether there was a difference between data in the paper-based VAS condition compared to the iPad VAS condition. For Student 1 there was no clear difference between duration of transition time, with the iPad VAS being a superior treatment condition to the iPad VAS only 60% of the time. The PND between baseline and the paper-based VAS and between baseline and the iPad VAS for Student 1 was 0%, showing no effect size for either VAS mode.

Student 2 had a median of 81 seconds for transition time during baseline data with high variance in data points. During baseline, the level of stability of data was only 40%. Baseline data had a range of 82 seconds, with an absolute change level of 73 seconds, showing an accelerating trend. When the paper-based VAS was implemented, Student 2 had a median of 59 seconds for transition time and a level stability of 60%. The range of transition time while implementing the paper-based VAS was 41 seconds, and the absolute change in level was 11 seconds in a decelerating trend direction. When the iPad VAS was implemented, Student 2 had a median of 72 seconds for transition time, with the level of stability only at 60%. The range of transition time while implementing the iPad VAS was 48 seconds, and the absolute change in level was 24 seconds in a decelerating trend direction. The PND between the paper-based VAS and the iPad VAS showed a divergence in duration of transition time, with the paper-based VAS being a superior treatment condition to the iPad VAS 80% of the time. The PND between baseline and the paper-based VAS was at 40%, and the PND between baseline and the iPad VAS for Student 2 was 20%, showing a low effect size for both VAS modes.

Student 3 had a median of 59 seconds for transition time during baseline data with some variance in data points. During baseline, the level of stability of data was 60%. Baseline data had a range of 169 seconds, with an absolute change level of 12 seconds, showing a decelerating trend. When the paper-based VAS was implemented, Student 3 had a median 51 seconds for transition time and a level stability of only 20%. The range of transition time while implementing the paper-based VAS was 63 seconds, and the absolute change in level was 39 seconds in an accelerating trend direction. When the iPad VAS was implemented, Student 3 had a median of 62 seconds for transition time and a level of stability of 40%. The range of transition time while implementing the iPad VAS was 51 seconds, and the absolute change in level was 20 seconds in an accelerating trend direction. The PND between the paper-based VAS and the iPad VAS showed no clear difference in duration of transition time, with the paper-based VAS being a superior treatment condition to the iPad VAS only 60% of the time (first, second, and third observation sessions). The PND between baseline and the paper-based VAS for Student 3 was 40%, showing a low effect size. The PND between baseline and the iPad VAS was 20%, also showing a low effect size.

Social Validity

Intervention Rating Profile-15

Social validity was assessed using the Intervention Rating Profile 15 (IRP-15) social validity questionnaire for this study. The IRP-15 was completed by the general education teacher, the special education teacher, the speech and language pathologist, and the special education paraprofessional on the use of the iPad VAS for each individual participant. All items were answered using a 6-point Likert scale, with 1 for *Strongly Disagree* and 6 for *Strongly Agree* (see Appendix O). Percentage of responses was calculated for each item by dividing the number of responses by 12 (total number of responses). Table 9 provides results of the responses for each item from the IRP-15.

Table 9: IRP-15 Results in Percentage of Total Responses

Question	Percentage of total responses					
	1	2	3	4	5	6
	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
1) This would be an acceptable intervention for a child's problem behavior.					92	8
2) Most teachers would find this intervention appropriate for behavior problems in addition to the one described.					92	8
3) This intervention should prove effective in changing a child's problem behavior.				42	58	
4) I would suggest this intervention to other teachers.					83	17
5) The child's behavior is severe enough to warrant use of this intervention.				8	25	67
6) Most teachers would find this intervention suitable for behavior problems described.					83	17
7) I would be willing to use this intervention in the classroom setting.					25	75
8) This intervention would *not* result in negative side-effects for the child.				25	67	8
9) This intervention would be appropriate for a variety of children.					58	42

Question	Percentage of total responses					
	1	2	3	4	5	6
	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
10) This intervention is consistent with those I have used in classroom settings.			25		67	8
11) The intervention was a fair way to handle the child's problem behavior.			8	8	42	42
12) This intervention is reasonable for the problem behavior described.					83	17
13) I liked the procedures used in this intervention.					75	25
14) This intervention is a good way to handle this child's behavior.			8	25	33	33
15) Overall, this intervention would be beneficial for a child.					83	17

Percentage = number of responses divided by 12 (total number of responses)

Most responses from adult respondents were either slightly agree, agree, or strongly agree. The only constructs that elicited negative responses, as determined by a slightly disagree, disagree, or strongly disagree response, were (10) this intervention is consistent with those I have used in classroom settings, (11) the intervention was a fair way to handle the child's problem behavior, and (14) this intervention is a good way to handle this child's behavior. The construct on the intervention being consistent with those I have used in my classroom was reported by the general education teacher for all three students, resulting in a 25% of total responses. The other two constructs that elicited a negative response were both reported only by the paraprofessional, resulting in 8% of total responses for those constructs.

Additionally, there were five constructs that received a response of "slightly agree." These include (3) this intervention should prove effective in changing a child's problem behavior, (5) the child's behavior is severe enough to warrant the use of this intervention, (8) this intervention would not result in negative side effects for the child, (11) this intervention is a fair way to handle the child's problem behavior, and (14) this intervention is a good way to handle this child's behavior. Slightly agree was selected by the special education teacher for the construct's being able to prove effective in changing a child's problem behavior, for all three participants, and by the paraprofessional for Student 2 and Student 3. Only the general education teacher responded with slightly agree for the construct, saying the behavior is severe enough to warrant the use of this intervention, and this was for Student 1. This intervention would not result in negative side effects was reported as slightly agree by the special education teacher for Student 1 and Student 3, and by the speech and language pathologist for Student 2. The paraprofessional responded with slightly agree for both constructs looking at the intervention's being a fair way to handle a child's problem behavior and a good way to handle this child's behavior for Student 1. Lastly, the special education teacher selected slightly agree for this intervention's being a good way to handle this child's behavior for both Student 1 and Student 2.

Participant Preference

Participants were given a preference assessment for both the iPad VAS and the paper-based VAS and asked why they preferred their choice. Following the conclusion of the study the primary investigator asked each participant which VAS they liked the best and why. Student 1 responded that he liked the iPad VAS best, but when asked why he responded that he didn't know why he just liked it better. Student 2 responded that he also preferred the iPad VAS and when asked why he responded that he thought iPads were cool. Student 3 responded that she liked the paper-based VAS best, but also was unable to provide a reason why and responded with "I don't know."

CHAPTER FIVE: DISCUSSION

Purpose of the Study

Policy and legislation support the inclusion of students with ASD in general education settings and the implementation of evidence-based practice (EBP) in the field of education. The Individuals with Disabilities Education Improvement Act (IDEIA, 2004) mandated that students with disabilities be required to receive educational services in the least restrictive environment. No Child Left Behind (2001) emphasized the use of EBP to increase student outcomes. Visual Activity Schedules (VAS) are one EBP for students with autism with a potential for implementation in general education. On-task behavior and transition problems can be especially evident when children with ASD are taught in general education or inclusive settings, and, with the current push for inclusive educational models, the use of activity schedules for children with ASD can be an important behavioral intervention component for schools to consider at the classroom and individual student level (Banda et al., 2009). Research and clinical practice has suggested that computers and technology may have positive effects on attention and performance in students with autism when compared to other forms of instruction (Dauphin et al., 2004). Currently the uses of portable electronic devices, specifically the iPad, are becoming tools for teaching students with disabilities. Research is underway to determine the effectiveness of this potential instructional tool, but there are few studies available on the use of iPads for students with ASD (Mechling, 2011).

The purpose of this research study was to examine the impact of VAS delivered via the iPad, compared to a paper-based VAS, on the percentage of on-task behavior and median transition time for students with ASD during academic center activities in an inclusive classroom setting. This study expands on the already established EBP of visual activity schedules for students with ASD (Banda et al., 2009; Dymond et al., 2007; MacDuff et al., 1993; Meadan et al., 2011; Simpson, 2005; Simpson & Myles, 2008). The impact of an iPad VAS application on participants' percentage of on-task behavior and time transitioning between academic literacy center activities for elementary students with a diagnosis of ASD is compared to a paper-based VAS.

Summary of Findings

Research Question 1

Was there a difference between an iPad VAS application compared to a paper-based Visual Activity Schedule for the percentage of on-task student behavior for students with Autism Spectrum Disorder during literacy center activities? Visual analysis of data for on-task behavior for the three participants included in this study was completed. The data provide preliminary information on how the two different VAS compare. The results support previous research using alternating treatment designs to compare technology-based visual supports and non-technology visual supports for students with autism showing mixed results across participants (Cihak, 2011; Flores et al., 2012; van der Meer, Sutherland et al., 2012). For Student 1 there was a divergence between percentage of on-task behavior, with the paper-based VAS being a superior treatment condition to the iPad VAS 80% of the time. Student 2 had a divergence between percentage of on-task behavior, with the iPad VAS being a superior treatment condition to the paper-based VAS 80% of the time. Student 3 had no clear divergence in percentage of on-task behavior between the iPad VAS and the paper-based VAS.

For Student 1 both modes of VAS appear to increase on-task behavior, with the paper-based VAS being a superior treatment condition to the iPad VAS 80% of the time. However, the effect sizes between baseline and both treatments were low. The effect size for the iPad VAS was small at 40%, and the effect size for the paper-based VAS was moderate at 60%. These effects sizes do not support research that the use of VAS for students with ASD increases on-task behavior (Bryan & Gast, 2000). The decelerating trend of the iPad VAS and the accelerating trend of the paper-based VAS also suggest the paper-based VAS to be a superior treatment compared to the iPad VAS. Although a divergence between the paper-based VAS and the iPad VAS did exist, neither VAS was a successful intervention for increasing on-task behavior for Student 1.

For Student 2, the iPad VAS was a superior treatment condition to the paper-based VAS 80% of the time. Additionally, on-task behavior was at a lower level using the paper-based VAS than the level of baseline data. Although there was a divergence between the paper-based VAS and the iPad VAS, neither intervention was successful for increasing on-task behavior. The effect sizes between baseline and treatment conditions for the paper-based VAS and the iPad VAS were low, at 20% and 40% respectively. These results also differ from past studies on VAS for students with ASD, which show this intervention to increase on-task behavior.

For Student 3, there was no clear difference for on-task behavior between the paper-based VAS and the iPad VAS, with the iPad VAS being a superior treatment condition only 60% of the time. Although there was no clear difference between VAS, both the paper-based VAS and the iPad VAS appear to increase on-task behavior with the iPad VAS having the highest level (median). The effect sizes for the paper-based VAS and the iPad VAS were moderate at 60% and high at 100%, respectively. This result supports previous research establishing the use of VAS to increase on-task behavior for students with ASD (Banda & Grimmett, 2008; Banda et al., 2009; Bryan & Gast, 2000; Dooley et al., 2001; Hall et al., 1995; Krantz et al., 1993; Massey & Wheeler, 2000). Although the results are mixed, the accelerating trend of the iPad VAS and the decelerating trend of the paper-based VAS coupled with the iPad VAS showing as a superior treatment condition 60% of the time present a justification for the iPad VAS having the potential of being more effective for increasing on-task behavior for Student 3.

Research Question 2

Was there a difference between an iPad VAS application compared to a paper-based Visual Activity Schedule for the duration of transition time as measured in seconds for students with Autism Spectrum Disorder during literacy center activities? Based on the visual analysis for the three participants included in this study, baseline and intervention data were highly variable for all three participants, with a level stability range of 20-60%. Stability range is the percent of the data that falls within 80% of the median score for that condition. Student 1 and Student 3 had no clear difference in transition time when comparing the paper-based VAS to the iPad VAS. Student 2 had a divergence in transition time data between the iPad VAS and the paper-based VAS, with the paper-based VAS being a superior treatment condition 90% of the time. Again, these results support previous research showing mixed results across participants using alternating treatment designs to compare technology-based visual supports and non-technology visual supports for students with autism (Cihak, 2011; Flores et al., 2012; van der Meer, Sutherland et al., 2012).

For Student 1 there was no clear difference between duration of transition time, with the iPad VAS being a superior treatment condition to the iPad VAS only 60% of the time. In addition, both modes of VAS appeared to increase duration of transition time, with an effect size of 0% between baseline and the paper-based VAS and between baseline and the iPad VAS. These data differ from the research of Dettmer et al. (2000) where the implementation of VAS decreased transition time for students with ASD. The results from Student 1 show an increase level in duration of transition time using both VAS, which might be due to the student's frequently forgetting the VAS at the previous literacy center and then needing to go back and retrieve it during the transition recording period (recording starts once instructional cue to transition was given and stopped once the student was at the correct literacy center and engaged in on-task behavior). Previous research on VAS included the use of a graduated guidance procedure or a prompt hierarchy system during the instruction of VAS for students with ASD to ensure accurate implementation of the intervention by the student (Massey & Wheeler, 2000; Morrison et al., 2002). The inclusion of this support may have led to a decrease, with Student 1 leaving the VAS at the previous literacy center and therefore decreased transition time.

For Student 2, there was a divergence in duration of transition time, with the paper-based VAS being a superior treatment condition to the iPad VAS 80% of the time. Although a divergence exists, the effect sizes between baseline and treatment conditions (paper-based VAS and iPad VAS) were at 40% and 20% respectively. Student 2 did have a clear divergence in VAS for the first six observation sessions of the treatment condition (100% PND), but data converged on observation sessions seven through ten. Of the first six observations each VAS mode was implemented three times, with the paper-based VAS showing lower transition times. This convergence could be due to events that occurred in the classroom during the last four days of intervention. During this week the general education teacher requested that the student not bring his preferred item (an angry birds figurine) to school. Student 2 previously kept the preferred item in his pocket during the school day, but a distraction the previous week caused the general education teacher to request this item be left at home. During the literacy block on observation session 14, Student 2 became upset that he did not have his preferred item. Additionally, on observation session 14, Student 2 had one of the lowest percentage of on-task behavior and one of the highest transition times observed during the study. At the end of the literacy block the general education teacher called Student 2's mother and asked her to bring in the preferred item. The general education teacher told Student 2 that if he wanted to have his preferred item with him, it needed to be in his pocket during all instructional activities, but that he could have it out during leisure, lunch, and recess. During the following two observation sessions, on-task behavior continued to increase and transition time decreased, which further suggests the change in behavior having been the effect of the change in environment (presence or absence of the preferred item).

For Student 3, there was no clear difference in duration of transition time, with the paper-based VAS being a superior treatment condition to the iPad VAS only 60% of the time. The effect sizes for the paper-based VAS and the iPad VAS were low, at 40% and 20%, respectively, for Student 3 as well. These data imply that the use of VAS alone did not decrease transition time, a finding that differs from previous research (Banda et al., 2009). Baseline data had a median transition time of 59 seconds and a decelerating data path, which may imply that the implementation of VAS to decrease transition time was not warranted. In addition, the data paths of the paper-based VAS and the iPad VAS were both in an accelerating trend, which also implies that the implementation of either is not a successful intervention for decreasing transition time for Student 3.

Social Validity

Social validity data were collected following the intervention for both the participants and teachers in this study. Teachers in the study completed the Intervention Rating Profile 15 (IRP-15) in which all but three responses from IRP-15 were positive, as indicated by selecting slightly agree, agree, or strongly agree. These data support previous research on the social validity of using iPad visual supports for students with ASD in inclusive settings (Cihak, Fahrenkrog et al., 2010; Cihak, Wright et al., 2010). The three constructs that elicited negative responses were (10) this intervention is consistent with those I have used in classroom settings, (11) the intervention was a fair way to handle the child's problem behavior, and (14) this intervention is a good way to handle this child's behavior. The construct on the intervention being consistent with those I have used in my classroom was reported by the general education teacher for each of the three participating students, representing 25% of total responses (3 out of 12 total responses). This response supports data that the use of VAS has primarily been researched and implemented in secluded settings and not in inclusive environments (Bryan & Gast, 2000). The other two constructs that elicited a negative response were both reported only by the paraprofessional, resulting in 8% of total responses for those constructs and also assess whether the intervention is a "good" or "fair" way to handle the student's behavior. These responses were reported only for Student 1, who had small effect when both VAS were implemented for on-task behavior and no effect for transition time. In fact, transition time increased for Student 3 and may not be a "good" or "fair" way to handle difficulty with transitioning for this student.

Participants were given a preference assessment for both the iPad VAS and the paper-based VAS and asked why they preferred their choice. Student 1 and Student 2 responded that they liked the iPad VAS best, and Student 3 responded that she liked the paper-based VAS best. Although Student 1 preferred the iPad VAS, the use of a paper-based VAS was more effective for increasing on-task behavior, while neither VAS decreased transition time. Although Student 2 preferred the iPad VAS, there were mixed results concerning which intervention may have been more effective, with the implementation of the iPad VAS showing an increase in on-task behavior and the paper VAS showing a decrease in transition time. Student 3 preferred the paper-based VAS, but results show that the iPad VAS and the paper-based VAS did not have a clear divergence. While past studies have found that student preferences can influence performance during an intervention (van der Meer, Sutherland et al., 2012), this study showed no clear pattern across students.

Potential Strengths

This study expands on current research on the use of VAS for students with ASD by comparing the efficacy of electronic devices compared to paper formats as suggested by Ganz et al. (2014). A strength of this study is that it meets What Works Clearinghouse standards for alternating treatment designs (Kratochwill et al., 2013): (a) the intervention was systematically implemented and manipulated, (b) minimum requirements for IOA was met, (c) the alternating treatment design included at least a minimum of five observations of treatment effect for each condition, and (d) there are at least five data points per condition.

Another strength of this study is that it expands on current research on the use of VAS by including a female participant. A review of the literature shows only one study that included a female participant when evaluating on-task behavior (Morrison et al., 2002), and no studies included a female participant when evaluating transitioning. In addition to including a female participant this study expands on current research by implementing VAS for students with ASD in inclusive settings. Of the studies reviewed in this study only five studies were conducted in inclusive settings and included treatment packages of visual supports (Cihak, Fahrenkrog et al., 2012; Cihak, Wright et al., 2010; Hall et al., 1995; Massey & Wheeler, 2000; Morrison et al., 2002), where this study implemented the use of VAS without additional interventions.

Although this study had a relatively small sample size of three participants, generalizations regarding the overall findings of this study should be made with caution (Horner et al., 2005). However, this study can be generalized to students with similar characteristics including: (a) diagnosis, (b) age, (c) inclusive classroom setting, and (d) reading levels. Further generalizations can be made for studies using similar electronic applications that follow the same VAS formats, including visual representations (line drawings, photographs, text) and layout (first-then, check off, top-to-bottom, left-to-right).

Limitations

Although single-subject design studies have become accepted for scientific use, there are various limitations that arise when using this design. The use of alternating treatment designs limits many threats to internal validity due to the relatively short time frame of the study and the fact that threats to extra-experimental events would typically influence performance under both conditions (Gast, 2010). However, alternating treatment design" s are subject to multi-treatment interference, or carryover effects, and sequential confounding effects (Slavin, 2007). The researcher attempted to minimize multi-treatment interference, or carryover effects, by implementing only one condition per day and attempted to control for sequential confounding effects by not having more than two consecutive sessions of the same condition (Gast, 2010). Additionally, each participant was in a different small group and had an individualized treatment condition schedule through random selection of treatments for each participant in order to minimize a counterbalance effect.

Another potential threat to internal validity in this study is the sensitivity of the metric used to collect data. This study used a whole interval measurement to record on-task behavior, which allows for the potential to underestimate behavior (Gast, 2010). Statistical regression towards the mean is also a common threat to internal validity. Therefore, to minimize the potential threat of regression towards the mean this study reported median transition time as opposed to mean transition time. A potential confounding variable in this study was student accuracy with implementing the VAS. Although this may be considered a confounding variable, the use of an alternating treatment design guards against many threats to internal validity, including extra-experimental events as they would typically influence performance under both conditions (Kratochwill et al., 2013).

Implications for Practice

The revelation that neither instructional method was an efficient educational intervention for students with ASD within an inclusive setting was a substantial finding. For this reason it is extremely important for practitioners to collect data on student performance and make data-driven decisions to initiate, continue, terminate, or change intervention. Likewise, practitioners need to weigh the pros and cons of technology and non-technology VAS prior to implementing either tool. When deciding whether to implement a VAS for students with ASD in an inclusive setting, practitioners need to consider the costs associated with both VAS, time necessary to create and implement both VAS, accessibility needs of students and accessibility features of technology VAS, and student preference for and experience with technology and non-technology tools.

When choosing a mode of VAS for students with ASD in inclusive settings, practitioners want to consider the costs involved in creating the instructional support. The iPad used in this study was an iPad 2, which can cost up to $400. In addition, the VAS application used in this study was about three dollars to download. The costs for the technology VAS is far more expensive than the costs of creating a paper-based VAS, which includes the cost of paper, printing, laminating, and Velcro. Although the costs for the iPad VAS far exceed the costs of the paper-based VAS, there are some advantages to the iPad VAS. One advantage is the ability to create individual schedules much more quickly than it takes to create the paper-based VAS. Conversely, the paper-based VAS has an advantage over the iPad VAS when making changes to the schedule. For example, if the students were going only to three literacy centers, instead of four literacy center, the paper-based VAS can be quickly manipulated to show this change. However, the iPad VAS would need to be edited or recreated to reflect the change in schedule.

Another consideration for practitioners when choosing a technology or non-technology VAS is the need of students. The iPad VAS offers many accessibility features that may be beneficial for particular students. The iPad VAS has the ability to include principles of Universal Design for Learning (UDL). These features include a visual timer and audio enhancements. The visual timer shows students how much time is left to complete an activity. This feature would increase accessibility for students who have difficulty with time and number concepts, because it shows the time decreasing by the reduction of color in the timer area instead of showing decreasing numbers. There is also an audio feature that includes prerecorded audio clips and allows for the recording of audio by the practitioner or student. This feature would increase accessibility for students who have visual impairments or strength in auditory processing. This feature can be added to the visual representation of the activity and is played once the student touches the visual representation. The prerecorded audio clip would read the name of the activity when the visual representation is touched on the "to do" side of the VAS. The prerecorded audio clip then says finished when the visual representation is moved from the "to do" sided to the "all done" side of the VAS. Practitioners who choose to record audio could include more explicit directions for completing the activity. This recording would also be played once the visual representation of the activity was touched. Each activity could have its own audio recording that would be played on the "to do" or "all done" side of the VAS. The explicit directions could assist students with difficulty following directions and staying on task and decrease the need for adult prompting.

Lastly, practitioners will want to consider student preference for and experience with technology and non-technology tools. The participants in the current study stated a preference for either the paper-based VAS (Student 3) or the iPad VAS (Student 1 and Student 2). However, this study did not show that one VAS system was clearly better than the other. Additionally, one student preferred the iPad VAS but had higher on-task behavior using the paper-based VAS. Although, this study did not take student preference into account when implementing the VAS, practitioners may want to consider student preference. When students are allowed to choose which VAS to implement they may have greater desire to use the VAS on a regular basis and in various settings. Student preference should be reassessed throughout the implementation of both VAS, as preferences for different VAS modes may change over time and could influence performance (van der Meer, Sutherland et al., 2012).

Along with considering student preference, practitioners need to consider student experience with technology. Students with limited experience with technology may have difficulty using the iPad and accessing the VAS application. Students with limited experience with technology may need more time during the instructional phase to independently manipulate the device and application. Students with limited experience with technology also might be more interested in playing with the iPad instead of using the iPad as an instructional or behavioral tool. These considerations, along with continuous data collection and analysis, should be made by practitioners before deciding to implement technology or non-technology VAS for students with ASD in inclusive settings.

Implication for Future Research

Suggestions for future research include considerations in the areas of: (a) participants, (b) setting, (c) data collection procedures, (d) implementation procedures, (e) treatment packages, and (f) additional visual supports for students with ASD in inclusive settings. Participants for this study included three students who received reading instruction in an inclusive K-1 classroom, had a primary diagnosis of ASD, and did not have an intellectual disability. Future research on the use of paper-based VAS and iPad VAS should include a larger sample size, students with varying disability profiles receiving education in inclusive settings, and older students with ASD in inclusive settings. Additionally, future research might explore the use of VAS for students with ASD in different inclusive settings, including different academic content areas, such as math, different schools, and different counties.

Future research would benefit from the inclusion of data on the frequency and level of prompts (verbal, gestural, physical) provided by the adults in the classroom and the accuracy of students' use of VAS. Current research on VAS for students in inclusive settings includes some measurement for prompts, including frequency and level (Cihak, Fahrenkrog et al., 2010; Cihak, Wright et al., 2010; Hall et al., 1995; Massey & Wheeler, 2000; Morrison et al., 2002). Inclusion of prompting data could have aided in assessing the efficacy of the interventions. Future research should also consider collecting data on the accuracy of student use of VAS, and collection of these data would provide information on whether the students are correctly using the VAS. A momentary time sampling procedure could be used to collect data on whether the visual representations of each literacy center activity were in the accurate location on the VAS base and whether the student was on-schedule and working at the center depicted on the student's VAS.

In this study the VAS was implemented by the primary investigator as a single intervention and not as an intervention package. Future research should consider having the practitioner implement the VAS in order to gain information on the practitioner's experience. These data could include the ease or difficulty for practitioners to set up both the paper-based VAS and the iPad VAS. These data could also provide insight on whether the use of VAS is a realistic intervention in a general education setting.

Current research on visual supports for students with ASD in inclusive settings has been implemented as treatment packages. In these studies, the use of VAS has been coupled with additional supports, including graduated guidance, systems of least-to-most prompts, and systems of most-to-least prompts. Future research is needed to determine whether VAS alone are appropriate interventions for students with ASD in inclusive settings.

This study compared only one form of visual support (VAS) through two different modes (paper-based and iPad) without additional accessibility features. Future research might include accessibility features and UDL principles available for iPad VAS, such as the use of audio and inclusion of visual timers. Based on a current review of literature, only five studies on the use of VAS for students with ASD were conducted in inclusive settings (Cihak, Fahrenkrog et al., 2010; Cihak, Wright et al., 2010; Hall et al., 1995; Massey & Wheeler, 2000; Morrison et al., 2002). Additionally, only three studies were found that compared technology visual supports to non-technology visual supports (Cihak, 2011; Flores et al., 2012; van der Meer, Sutherland et al., 2012). Future research might compare additional technology and non-technology visual supports (first-then boards, visual scripts or social stories, and visual task analysis) to determine efficacy in inclusive settings.

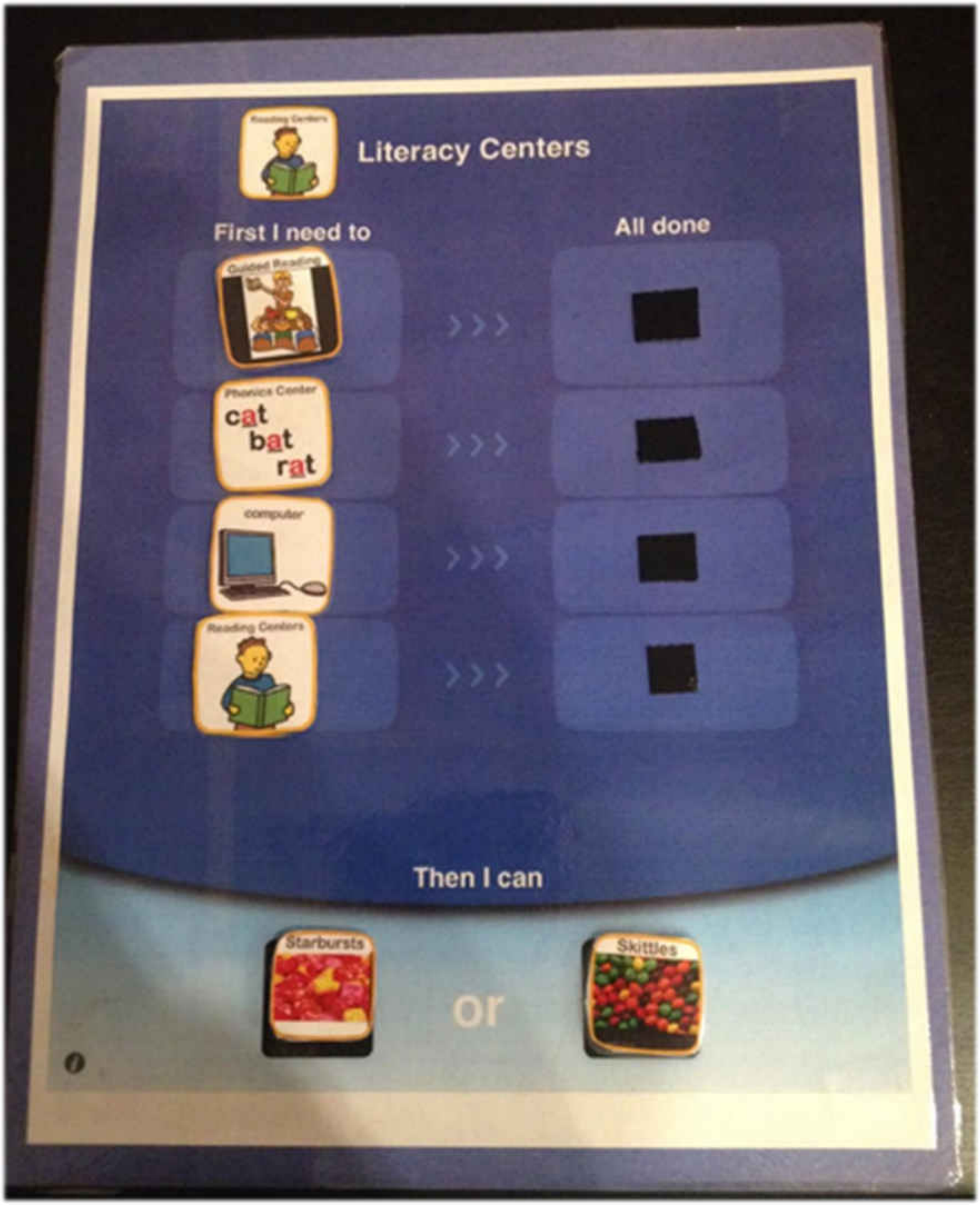
Conclusion

This research examined the impact of VAS delivered via the iPad compared to a paper-based VAS on the percentage of on-task behavior and median transition time for students with autism spectrum disorder (ASD) during academic center activities in an inclusive classroom setting. An alternating-treatment, single-subject research design was used to determine whether a divergence exists between the paper-based VAS and the iPad VAS. This study included three student participants who (a) had a diagnosis of ASD as stated on the Individualized Education Plan (IEP), (b) were in grade level K-1, (c) received instruction through Language Arts activity centers taught within one classroom, and (d) had difficulty with independent on-task behavior as reported by the participant's teacher.

Visual analysis of the data for on-task behavior revealed mixed results. Student 1 had a divergence between on-task behavior, with the paper-based VAS being a superior treatment condition to the iPad VAS 80% of the time. Student 2 also had a divergence between percentage of on-task behavior, with the iPad VAS being a superior treatment condition to the paper-based VAS 80% of the time. Student 3 had no clear divergence in percentage of on-task behavior between the iPad VAS and the paper-based VAS. All three participants had highly variable baseline and intervention data for transition time with a level stability range of 20% to 60%. Student 1 and Student 3 had no clear difference in transition time when comparing the paper-based VAS to the iPad VAS. Student 2 had a divergence in transition time data between the iPad VAS and the paper-based VAS, with the paper-based VAS being a superior treatment condition 90% of the time.

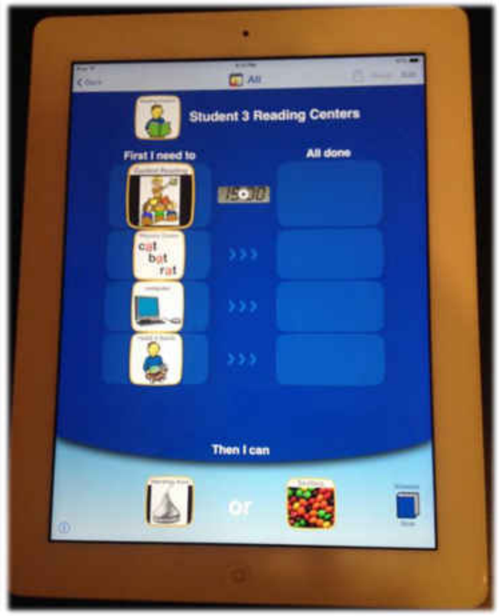
The data from this study provide preliminary information on how two different VAS compare. The results showed that neither instructional method was an efficient educational intervention for students with ASD, within an inclusive setting. For this reason it is extremely important for practitioners to collect data on student performance and make data-driven decisions to continue, terminate, or change intervention. Likewise, practitioners need to weigh the pros and cons of technology and non-technology VAS prior to implementing either tool. When deciding whether or not to implement a VAS for students with ASD in an inclusive setting, practitioners need to consider the costs associated with both VAS, time necessary to create and implement both VAS, accessibility needs of students and accessibility features of technology VAS, and student preference for and experience with technology and non-technology tools.

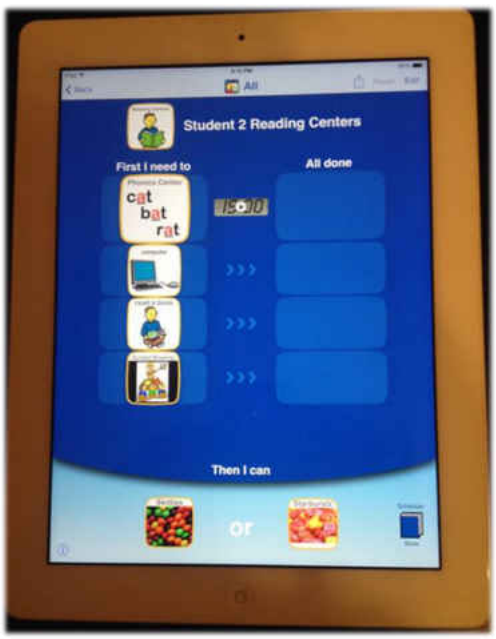
APPENDIX A: IMAGE OF PAPER-BASED VAS


Literacy Centers
First I need to
All done
Guided Reading
Phonics Center
cat
bat
rat
computer
Reading Centers
Then I can
Starbursts
or
Skittles

APPENDIX B: IMAGE OF IPAD VAS


All
Student 1 Reading Centers
First I need to
All done
Then I can
or


All
Student 3 Reading Centers
First I need to
All done
Then I can
or


All
Student 2 Reading Centers
First I need to
All done
cat
bat
rat
Then I can
or

APPENDIX C: GUIDED READING LESSON PLANS

October 28: Fairytale leveled books- sequence review

October 29: Fairytale leveled books- sequence review

October 30: Fairytale leveled books- sequence review

October 31: No Literacy Centers- Character Parade

November 1: No Literacy Centers

November 4: Winter Themed leveled books- introduce author's purpose/entertainment

November 5: Winter Themed leveled books- author's purpose/entertainment

November 6: Winter Themed leveled books- author's purpose/entertainment

November 7: Winter Themed leveled books- author's purpose/entertainment

November 8: Poetry leveled books- introduce rhyming words

November 11: Winter Themed leveled books- compare and contrast; sequencing

November 12: Winter Themed leveled books- compare and contrast; sequencing

November 13: Winter Themed leveled books- compare and contrast; sequencing

November 14: Winter Themed leveled books- compare and contrast; sequencing

November 15: Poetry leveled books- rhyming words

November 18: If You Give a Mouse a Cookie- cause and effect

November 19: If You Give a Mouse a Cookie- cause and effect

November 20: If You Give a Pig a Pancake- cause and effect

November 21: If You Give a Pig a Pancake- cause and effect

APPENDIX D: PHONICS LESSON PLANS

Phonics Lesson Plans from Florida Center for Reading Research K-1 Literacy Center Activities

October 28: FCRR P.041- High Frequency Words: Sandpaper- objective: read high frequency words

October 29: FCRR P.041- High Frequency Words: Sandpaper- objective: read high frequency words

October 30: FCRR P.045- High Frequency Words: Word Memory Game- objective: read high frequency words

October 31: No Literacy Centers- Character Parade

November 1: No Literacy Centers

November 4: FCRR P.055- Syllable Patterns: Syllable Closed Sort- objective: segment syllables in words

November 5: FCRR P.055- Syllable Patterns: Syllable Closed Sort- objective: segment syllables in words

November 6: FCRR P.056- Syllable Patterns: Word Syllable Game- objective: segment syllables in words

November 7: FCRR P.056- Syllable Patterns: Word Syllable Game- objective: segment syllables in words

November 8: FCRR P.029- Onset and Rime: Rime Closed Sort- objective: blend onsets and rimes to make words

November 11: FCRR P.016- Letter-Sound Correspondence: Letter-Sound Dominos- objective: match initial phonemes to graphemes

November 12: FCRR P.016- Letter-Sound Correspondence: Letter-Sound Dominos- objective: match initial phonemes to graphemes

November 13: FCRR P.018- Letter-Sound Correspondence: Letter-Sound Pyramid- objective:

match final phonemes to graphemes

November 14: FCRR P.018- Letter-Sound Correspondence: Letter-Sound Pyramid- objective: match final phonemes to graphemes

November 15: FCRR P.031- Onset and Rime: Change-A-Word- objective: blend onsets and rimes to make words

November 18: FCRR P.019- Letter-Sound Correspondence: Letter-Sound Folder Sort- objective: match final phonemes to graphemes

November 19: FCRR P.020- Letter-Sound Correspondence: Letter-Sound Train- objective: match medial phonemes to graphemes

November 20: FCRR P.020- Letter-Sound Correspondence: Letter-Sound Train- objective: match medial phonemes to graphemes

November 21: FCRR P.022- Letter-Sound Correspondence: Letter-Sound Bingo- objective: match medial phonemes to graphemes

APPENDIX E: IRB APPROVAL

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Jillian R. Gourwitz** and Co-PI: **Suzanne M. Martin**

Date: **October 14, 2013**

Dear Researcher:

On 10/14/2013, the IRB approved the following human participant research until 10/13/2014 inclusive:

Type of Review:	UCF Initial Review Submission Form
Project Title:	iPads for Students with ASD: Comparing Delivery Modes for Visual Activity Schedules
Investigator:	Jillian R. Gourwitz
IRB Number:	SBE-13-09701
Funding Agency:	
Grant Title:	
Research ID:	N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form cannot be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu.

If continuing review approval is not granted before the expiration date of 10/13/2014, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 10/14/2013 03:01:46 PM EDT

IRB Coordinator

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APPENDIX F: SCRIPT FOR INTRODUCING PAPER- BASED VAS

Researcher: This is your visual activity schedule for reading centers. What is the first center you go to?

Student: “center one”

Follow response procedure stated at the end of the script

Researcher: When the timer sounds or your teacher tells you to go to the next center you will move “center one” to the *all* done side of the visual schedule.

Student moves activity from the “to do” to the “all done” side

Researcher: What is the next center you go to?

Follow response procedure stated at the end of the script

Researcher: When the timer sounds or your teacher tells you to go to the next center you will move “center two” to the *all* done side of the visual schedule.

Student moves activity from the “to do” to the “all done” side

Researcher: What is the next center you go to?

Follow response procedure stated at the end of the script

Researcher: When the timer sounds or your teacher tells you to go to the next center you will move “center three” to the *all* done side of the visual schedule.

Student moves activity from the “to do” to the “all done” side

Researcher: What is the last center you go to?

Follow response procedure stated at the end of the script

Researcher: When the timer sounds or your teacher tells you to go to the next center you will move “center four” to the *all* done side of the visual schedule.

Student moves activity from the “to do” to the “all done” side

Researcher: Now all your center activities are on the *all done* side of your schedule and now you get the reinforcer your teacher chose for completing all of your literacy centers

Response procedure:

If correct response

Researcher: Yes. “Center one”

If incorrect response

Researcher: The first center you go to is “center one”. What center?

Student: “center one”

APPENDIX G: SCRIPT FOR INTRODUCING IPAD VAS

Researcher: To get to the visual schedule app you touch the Choiceworks^{TM} picture on the home page.

Student touches the app

Researcher: This is your visual activity schedule for reading centers. What is the first center you go to?

Student: "center one"

Follow response procedure stated at the end of the script

Researcher: Once you are at "center one" and ready to work you will push the timer button in the middle of the schedule.

Student touches timer button

Researcher: When the timer sounds or your teacher tells you to go to the next center you will move "center one" to the *all* done side of the visual schedule.

Student moves activity from the "to do" to the "all done" side

Researcher: What is the next center you go to?

Follow response procedure stated at the end of the script

Researcher: Once you are at "center two" and ready to work you will push the timer button in the middle of the schedule.

Student touches timer button

Researcher: When the timer sounds or your teacher tells you to go to the next center you will move "center two" to the *all* done side of the visual schedule.

Student moves activity from the "to do" to the "all done" side

Researcher: What is the next center you go to?

Follow response procedure stated at the end of the script

Researcher: Once you are at "center three" and ready to work you will push the timer button in the middle of the schedule.

Student touches timer button

Researcher: When the timer sounds or your teacher tells you to go to the next center you will move "center three" to the *all* done side of the visual schedule.

Student moves activity from the "to do" to the "all done" side

Researcher: What is the last center you go to?

Follow response procedure stated at the end of the script

Researcher: Once you are at "center four" and ready to work you will push the timer button in the middle of the schedule.

Student touches timer button

Researcher: When the timer sounds or your teacher tells you to go to the next center you will move “center four” to the *all* done side of the visual schedule.

Student moves activity from the “to do” to the “all done” side

Researcher: Now all your center activities are on the *all done* side of your schedule and now you get the reinforcer your teacher chose for completing all of your literacy centers

Response procedure:

If correct response

Researcher: Yes. “Center one”

If incorrect response

Researcher: The first center you go to is “center one”. What center?

Student: “center one”

APPENDIX H: INSTRUCTION LETTER FOR TEACHERS

Dear Colleague,

You have been invited to participate in a dissertation study to help develop and test the effectiveness of the implementation of visual schedules both paper-based and technology based, The Choiceworks™ Visual Support System, during academic centers for students diagnosed with Autism Spectrum Disorder. This dissertation is being conducted as part of the graduate expectations in the Exceptional Education PhD program and with the consent from the developers of The Choiceworks™ Visual Support System app. The purpose of this dissertation is to compare the impact of The Choiceworks™ Visual Support System application and the paper-based visual activity schedule on student behavior for students with Autism Spectrum Disorder during academic center activities.

Students participating in this dissertation study was instructed on the use of each visual activity schedule to the point of mastery for independent use. Therefore, it is imperative that the individuals working with student participants do not prompt, direct, or instruct the students to use the visual activity schedules throughout the entire study.

The potential benefits of participating in this dissertation include learning more about different modes to implement visual activity schedules for students with Autism Spectrum Disorder.

Please direct questions to: Jillian Gourwitz, M.Ed. (407) 618-6317, jillian.gourwitz@knights.ucf.edu.

Sincere thanks for your participation in this dissertation study on visual activity schedules.

Most sincerely,

Jillian R. Gourwitz, M.Ed.

Doctoral Scholar
Principal Investigator

APPENDIX I: DATA COLLECTOR TRAINING PROTOCOL

The two independent observers were volunteers from a doctoral program in special education at a large university. The two independent observers met with the primary investigator the week before baseline videos were recorded. The primary investigator met with the two independent observers in a private conference room, at the university, that provided a projection screen. The data collector training session lasted for one and a half hours. The primary investigator provided information on the two dependent variables including their operational definitions, procedure for collecting whole interval data, procedures for collecting transition data, and how to document behavior on the data collection form.

On-task was defined as the participant is (a) visually attending to the appropriate scheduled materials; or (b) looking at their picture activity schedule; or (c) manipulating the appropriate scheduled materials, (i.e., as they were designed to be used) (MacDuff, Krantz, & McClannahan, 1993; Bryan & Gast, 2002; Pelios, Macduff, & Axelrod, 2003).

Transition time was defined as the total time it took for the students to transition from one academic center to the next academic center on their visual activity schedule when given a signal to transition. The timer began when the cue to transition was given, which was designated by the sound of the teacher timer, and concluded when the student was in the academic center area and engaging in on-task behavior for that activity center. Transition time was recorded for all three transitions between small group literacy centers a median transition time was reported for data analysis.

A 10 second whole interval procedure was used as the primary dependent measure of on-task behavior and a percentage of on-task behavior was calculated for each observation. Due to the potential variance of opportunity for on-task behavior to occur in the natural classroom environment the researcher has chosen an interval recording data collection method to measure per opportunity for on-task behavior. Interval recording divides the observation period into equal intervals and records the occurrence or non-occurrence of the target behavior during each interval (Gast, 2010). Whole interval measurement records the target behavior as present if the behavior occurred during the entire interval period.

Duration of transition was used to record the dependent variable of transition time. Data on duration of transition time was collected for the transitions between the four small group literacy centers. The data collector starts the timer once the cue to transition was given to the whole class, as designated by the teacher timer, and stopped once the participant was at the appropriate center and engaging in on-task behavior for activity.

The primary investigator then showed sample classroom videos that included the 10 second timer that was narrated throughout the digital recording. Independent data collectors reviewed three ten minute sample classroom videos that each included one transition. The independent data collectors collected data on on-task behavior using a 10 second whole interval procedure and collect data on transition time using a stopwatch to record duration of transition time. After each ten minute sample video the primary investigator calculated IOA for on-task behavior. After the three sample videos the primary investigator calculated IOA for transition time determined as an agreement if the duration of transition time was within 5 seconds of the other observer. Interobserver agreement (IOA) for training of observers was at least 80% on two out of three trials for both on-task behavior and transition.

Next, the primary investigator reviewed the task analysis forms for instruction of VAS and implementation of VAS. Independent data collectors were informed that they were to check a “yes” or a “no” if each step in the task analysis was completed by the primary investigator.

The primary investigator then provided time for questions and answers. Once all observer questions were answered the primary investigator provided the independent observers with the data collection forms for each participant, task analysis form for instruction on VAS, and the task analysis form for implementation of VAS.

APPENDIX J: TASK ANALYSIS OF INTERVENTION FOR PAPER-BASED VAS

Student Name:___________________________

Observation Session: ________________________

Steps for Implementing the Paper-Based VAS	YES	NO
General Education teacher dismisses small groups from the whole group lesson to go to their first literacy center.		
Primary Investigator hands Paper-Based VAS to student participant in the group called.		
Primary Investigator tells the student that “this is your VAS for today”		
Primary Investigator asks the student “which reward are you working for today”		
Student says or points to the reward they are working for		
Student takes Paper-Based VAS		
Student heads to literacy center		

APPENDIX K: TASK ANALYSIS FOR INTERVENTION FOR IPAD VAS

Student Name:____________________________

Observation Session: _________________________

Steps for Implementing the iPad VAS	YES	NO
General Education teacher dismisses small groups from the whole group lesson to go to their first literacy center.		
Primary Investigator hands iPad VAS to student participant in the group called.		
Primary Investigator tells the student that "this is your VAS for today"		
Primary Investigator tells the student to open the VAS application		
Primary Investigator tells the student to open the VAS with their name on it		
Primary Investigator asks the student "which reward are you working for today"		
Student says or points to the reward they are working for		
Student takes iPad VAS		
Student heads to literacy center		

APPENDIX L: DATA COLLECTION FORM

Whole Interval Record Sheet
Jillian Gourwitz Dissertation

Student:______________________ **Date/Time:**______________________
Observer:______________________ **Intervention:**______________________

On-Task: (a) visually attending to the appropriate scheduled materials; (b) looking at their picture activity schedule; (c) manipulating the appropriate scheduled materials, (i.e., as they were designed to be used); or (d) looking at or attending to adult teaching the center.
Off-Task: (a) using materials in a manner other than that for which they were designed; (b) manipulating but not visually attending to the materials (i.e., engaging in tactile self-stimulatory behavior with an object); (c) engaging in an inappropriate behavior (e.g., refusals, tantrums, stereotypical behaviors); or (d) not engaging in activities or using materials.

Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior
:10		3:10		6:10		9:10		12:10		15:10		18:10	
:20		3:20		6:20		9:20		12:20		15:20		18:20	
:30		3:30		6:30		9:30		12:30		15:30		18:30	
:40		3:40		6:40		9:40		12:40		15:40		18:40	
:50		3:50		6:50		9:50		12:50		15:50		18:50	
1:00		4:00		7:00		10:00		13:00		16:00		19:00	
1:10		4:10		7:10		10:10		13:10		16:10		19:10	
1:20		4:20		7:20		10:20		13:20		16:20		19:20	
1:30		4:30		7:30		10:30		13:30		16:30		19:30	
1:40		4:40		7:40		10:40		13:40		16:40		19:40	
1:50		4:50		7:50		10:50		13:50		16:50		19:50	
2:00		5:00		8:00		11:00		14:00		17:00		20:00	
2:10		5:10		8:10		11:10		14:10		17:10		20:10	
2:20		5:20		8:20		11:20		14:20		17:20		20:20	
2:30		5:30		8:30		11:30		14:30		17:30		20:30	
2:40		5:40		8:40		11:40		14:40		17:40		20:40	
2:50		5:50		8:50		11:50		14:50		17:50		20:50	
3:00		6:00		9:00		12:00		15:00		18:00		21:00	

Codes for Behavior	Transition Time (1)	Transition Time (2)	Transition Time (3)
X= On-Task O= Off-Task T= Transition between Activities /= If out of view	______ Time	______ Time	______ Time

Whole Interval Record Sheet
Jillian Gourwitz Dissertation

Student:______________________________ **Date/Time:**____________________
Observer:______________________________ **Intervention:**____________________

On-Task: (a) visually attending to the appropriate scheduled materials; (b) looking at their picture activity schedule; (c) manipulating the appropriate scheduled materials, (i.e., as they were designed to be used); or (d) looking at or attending to adult teaching the center.
Off-Task: (a) using materials in a manner other than that for which they were designed; (b) manipulating but not visually attending to the materials (i.e., engaging in tactile self-stimulatory behavior with an object); (c) engaging in an inappropriate behavior (e.g., refusals, tantrums, stereotypical behaviors); or (d) not engaging in activities or using materials.

Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior
21:10		24:10		27:10		30:10		33:10		36:10		39:10	
21:20		24:20		27:20		30:20		33:20		36:20		39:20	
21:30		24:30		27:30		30:30		33:30		36:30		39:30	
21:40		24:40		27:40		30:40		33:40		36:40		39:40	
21:50		24:50		27:50		30:50		33:50		36:50		39:50	
22:00		25:00		28:00		31:00		34:00		37:00		40:00	
22:10		25:10		28:10		31:10		34:10		37:10		40:10	
22:20		25:20		28:20		31:20		34:20		37:20		40:20	
22:30		25:30		28:30		31:30		34:30		37:30		40:30	
22:40		25:40		28:40		31:40		34:40		37:40		40:40	
22:50		25:50		28:50		31:50		34:50		37:50		40:50	
23:00		26:00		29:00		32:00		35:00		38:00		41:00	
23:10		26:10		29:10		32:10		35:10		38:10		41:10	
23:20		26:20		29:20		32:20		35:20		38:20		41:20	
23:30		26:30		29:30		32:30		35:30		38:30		41:30	
23:40		26:40		29:40		32:40		35:40		38:40		41:40	
23:50		26:50		29:50		32:50		35:50		38:50		41:50	
24:00		27:00		30:00		33:00		36:00		39:00		42:00	

Codes for Behavior
X= On-Task
O= Off-Task
T= Transition between Activities
/= If out of view

Whole Interval Record Sheet
Jillian Gourwitz Dissertation

Student:_______________ **Date/Time:**_______________
Observer:_______________ **Intervention:**_______________

On-Task: (a) visually attending to the appropriate scheduled materials; (b) looking at their picture activity schedule; (c) manipulating the appropriate scheduled materials, (i.e., as they were designed to be used); or (d) looking at or attending to adult teaching the center.
Off-Task: (a) using materials in a manner other than that for which they were designed; (b) manipulating but not visually attending to the materials (i.e., engaging in tactile self-stimulatory behavior with an object); (c) engaging in an inappropriate behavior (e.g., refusals, tantrums, stereotypical behaviors); or (d) not engaging in activities or using materials.

Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior
42:10		45:10		48:10		51:10		54:10		57:10		60:10	
42:20		45:20		48:20		51:20		54:20		57:20		60:20	
42:30		45:30		48:30		51:30		54:30		57:30		60:30	
42:40		45:40		48:40		51:40		54:40		57:40		60:40	
42:50		45:50		48:50		51:50		54:50		57:50		60:50	
43:00		46:00		49:00		52:00		55:00		58:00		61:00	
43:10		46:10		49:10		52:10		55:10		58:10		61:10	
43:20		46:20		49:20		52:20		55:20		58:20		61:20	
43:30		46:30		49:30		52:30		55:30		58:30		61:30	
43:40		46:40		49:40		52:40		55:40		58:40		61:40	
43:50		46:50		49:50		52:50		55:50		58:50		61:50	
44:00		47:00		50:00		53:00		56:00		59:00		62:00	
44:10		47:10		50:10		53:10		56:10		59:10		62:10	
44:20		47:20		50:20		53:20		56:20		59:20		62:20	
44:30		47:30		50:30		53:30		56:30		59:30		62:30	
44:40		47:40		50:40		53:40		56:40		59:40		62:40	
44:50		47:50		50:50		53:50		56:50		59:50		62:50	
45:00		48:00		51:00		54:00		57:00		60:00		63:00	

Codes for Behavior
X= On-Task
O= Off-Task
T= Transition between Activities
/= If out of view

Whole Interval Record Sheet
Jillian Gourwitz Dissertation

Student:______________________ **Date/Time:**______________________
Observer:______________________ **Intervention:**______________________

On-Task: (a) visually attending to the appropriate scheduled materials; (b) looking at their picture activity schedule; (c) manipulating the appropriate scheduled materials, (i.e., as they were designed to be used); or (d) looking at or attending to adult teaching the center.
Off-Task: (a) using materials in a manner other than that for which they were designed; (b) manipulating but not visually attending to the materials (i.e., engaging in tactile self-stimulatory behavior with an object); (c) engaging in an inappropriate behavior (e.g., refusals, tantrums, stereotypical behaviors); or (d) not engaging in activities or using materials.

Time	Behavior	Time	Behavior	Time	Behavior	Time	Behavior	Notes
63:10		66:10		69:10		72:10		
63:20		66:20		69:20		72:20		
63:30		66:30		69:30		72:30		
63:40		66:40		69:40		72:40		
63:50		66:50		69:50		72:50		
64:00		67:00		70:00		73:00		
64:10		67:10		70:10		73:10		
64:20		67:20		70:20		73:20		
64:30		67:30		70:30		73:30		
64:40		67:40		70:40		73:40		
64:50		67:50		70:50		73:50		
65:00		68:00		71:00		74:00		
65:10		68:10		71:10		74:10		
65:20		68:20		71:20		74:20		
65:30		68:30		71:30		74:30		
65:40		68:40		71:40		74:40		
65:50		68:50		71:50		74:50		
66:00		69:00		72:00		75:00		

Codes for Behavior
X= On-Task
O= Off-Task
T= Transition between Activities
/= If out of view

APPENDIX M: TASK ANALYSIS FOR PAPER-BASED INSTRUCTIONAL SCRIPT

Student Name:____________________________

Training Session: _________________________

Directions: Mark the box under the YES column if the primary investigator stated the phrase. Mark the box under the NO column if the researcher did not state the phrase.

PRIMARY INVESTIGATOR'S PHRASE	**YES**	**NO**
This is your visual activity schedule for reading centers. What is the first center you go to?		
When the timer sounds or your teacher tells you to go to the next center you will move "center one" to the *all* done side of the visual schedule.		
What is the next center you go to?		
When the timer sounds or your teacher tells you to go to the next center you will move "center two" to the *all* done side of the visual schedule.		
What is the next center you go to?		
When the timer sounds or your teacher tells you to go to the next center you will move "center three" to the *all* done side of the visual schedule.		
What is the last center you go to?		
When the timer sounds or your teacher tells you to go to the next center you will move "center four" to the *all* done side of the visual schedule.		
Now all your center activities are on the *all done* side of your schedule and now you get the reinforcer your teacher chose for completing all of your literacy centers		

APPENDIX N: TASK ANALYSIS FOR IPAD INSTRUCTIONAL SCRIPT

Student Name:____________________________

Training Session: _________________________

Directions: Mark the box under the YES column if the primary investigator stated the phrase. Mark the box under the NO column if the researcher did not state the phrase.

PRIMARY INVESTIGATOR'S PHRASE	**YES**	**NO**
To get to the visual schedule app you touch the Choiceworks™ picture on the home page.		
Now find the schedule with your name and touch it to open it		
This is your visual activity schedule for reading centers. What is the first center you go to?		
Once you are at "center one" and ready to work you will push the timer button in the middle of the schedule.		
When the timer sounds or your teacher tells you to go to the next center you will move "center one" to the *all* done side of the visual schedule.		
What is the next center you go to?		
Once you are at "center two" and ready to work you will push the timer button in the middle of the schedule.		
When the timer sounds or your teacher tells you to go to the next center you will move "center two" to the *all* done side of the visual schedule.		
What is the next center you go to?		
Once you are at "center three" and ready to work you will push the timer button in the middle of the schedule.		
When the timer sounds or your teacher tells you to go to the next center you will move "center three" to the *all* done side of the visual schedule.		
What is the last center you go to?		
Once you are at "center four" and ready to work you will push the timer button in the middle of the schedule.		
When the timer sounds or your teacher tells you to go to the next center you will move "center four" to the *all* done side of the visual schedule.		
Now all your center activities are on the *all done* side of your schedule and now you get the reinforcer your teacher chose for completing all of your literacy centers		

APPENDIX O: INTERVENTION RATING PROFILE (IRP-15)

Please rate the intervention along the following dimensions. Please circle the number which best describes your agreement or disagreement with each statement. The intervention for this rating scale is the ***Visual Activity Schedule*** *presented using the* ***iPad****. The problem behavior for this rating scale includes* ***on-task behavior*** *and* ***transition time*** *between activities.*

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1. This would be an acceptable intervention for a child's problem behavior.	**1**	**2**	**3**	**4**	**5**	**6**
2. Most teachers would find this intervention appropriate for behavior problems in addition to the one described.	**1**	**2**	**3**	**4**	**5**	**6**
3. This intervention should prove effective in changing a child's problem behavior.	**1**	**2**	**3**	**4**	**5**	**6**
4. I would suggest this intervention to other teachers.	**1**	**2**	**3**	**4**	**5**	**6**
5. The child's behavior is severe enough to warrant use of this intervention.	**1**	**2**	**3**	**4**	**5**	**6**
6. Most teachers would find this intervention suitable for behavior problem described.	**1**	**2**	**3**	**4**	**5**	**6**
7. I would be willing to use this intervention in the classroom setting.	**1**	**2**	**3**	**4**	**5**	**6**
8. This intervention would *not* result in negative side-effects for the child.	**1**	**2**	**3**	**4**	**5**	**6**
9. This intervention would be appropriate for a variety of children.	**1**	**2**	**3**	**4**	**5**	**6**
10. This intervention is consistent with those I have used in classroom settings.	**1**	**2**	**3**	**4**	**5**	**6**
11. The intervention was a fair way to handle the child's problem behavior.	**1**	**2**	**3**	**4**	**5**	**6**
12. This intervention is reasonable for the problem behavior described.	**1**	**2**	**3**	**4**	**5**	**6**
13. I liked the procedures used in this intervention.	**1**	**2**	**3**	**4**	**5**	**6**
14. This intervention is a good way to handle this child's behavior.	**1**	**2**	**3**	**4**	**5**	**6**
15. Overall, this intervention would be beneficial for a child.	**1**	**2**	**3**	**4**	**5**	**6**

APPENDIX P: PERMISSION FROM BEEVISUAL

Michele Walker <mwalker@beevisual.com>
Thu 1/10/2013 5:26 PM

Hi Jillian,

Thank you so much for contacting us. You absolutely have my permission to use the name of our product (and images if need be) in your papers and dissertation. How exciting!

If I can be of any help at all to you throughout the process, please let me know. I would love to see your completed work, if you feel comfortable sharing.

If you need to pick my brain about anything, please do! We are and will be continuing to upgrade and update the apps features and functionality. I can share our plans with you and would love any feedback you many have.

I wish you all the best.

Michele

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