THESIS

THE EFFECTS OF INTEGRATING THE IPAD® WITH ACADEMIC MUSIC THERAPY INTERVENTIONS ON ENGAGEMENT WITH CHILDREN ON THE AUTISM SPECTRUM

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ABSTRACT

THE EFFECTS OF INTEGRATING THE IPAD® WITH ACADEMIC MUSIC THERAPY INTERVENTIONS ON ENGAGEMENT WITH CHILDREN ON THE AUTISM SPECTRUM

The purpose of this study was to determine whether integrating the use of the iPad® with music therapy could enhance academic engagement in children on the autism spectrum. Academic environments and tasks are individualized on many levels. It is necessary to explore interventions that foster academic engagement while taking into consideration the importance of individualization, motivation, and novelty. Two individuals (one male, one female) on the autism spectrum were recruited to participate in sessions that examined the use of music therapy, the iPad®, and the combination on academic tasks. One participant practiced multiplication facts (times tables with factors zero to twelve). The other participant completed elapsed time exercises (calculating time passed given two time of day). Academic engagement was measured by two observers and scored in each of the four conditions and compared to suggest which condition is most appropriate to facilitate intervention. Scores were graphically displayed for comparison and inter rater reliability was determined. Though the iPad and music therapy condition yielded the highest scores for both participants, inter rater reliability resulted in a wide range. Suggestions of limitations and further research are discussed.

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CHAPTER 1: INTRODUCTION

Purpose of Study

The purpose of this study is to determine whether or not the iPad® could enhance music therapy sessions by reducing challenging behaviors and increasing engagement when addressing an academic task. The study aims to replicate a previous study by Neely et al. (2013) that examined whether simply replacing a traditional academic material (flashcards or pen and paper) with an iPad® app with a shared function would increase the ability to accurately complete the academic task in two children on the autism spectrum. Neely et al. (2013) determined that the use of the iPad® increased engagement to task and decreased challenging behaviors. Music therapy also addresses academic goals. The outcome of this study may add to the existing knowledge that the use of iPad® can enhance engagement when addressing academic goals. It may also add to music therapy literature that technology may enhance the music therapy process in children on the autism spectrum.

Statement of Problem

Autism spectrum disorder is a neurodevelopmental disorder that is currently estimated to affect 1 in 68 children in the United States (Center for Disease Control [CDC], 2014). Autism is five times more likely to be diagnosed in boys compared with girls (CDC, 2014) and occurs across race and socioeconomic status. The estimate of those affected on the autism spectrum continues to grow. The current statistic is 120% higher than the incidence reported in 2000. Though treatment and diagnostic information also continue to evolve, there is still a pressing need to develop effective treatment and help for individuals and families affected by autism spectrum disorder (CDC, 2014). Challenging behaviors and difficulty engaging with others are a

struggle for many children on the autism spectrum. More research on interventions that takes these challenges into consideration is needed.

Rationale for Study

In addition to individuals and families, other professionals are in need of effective techniques for helping individuals on the autism spectrum. With the changing diagnostic criteria and rise in incidence, it is important for all professionals to remain current on best practices. Since music therapists often work with school age children with autism in and outside of the school setting it is important to also remain current on academic expectations. Students on the autism spectrum benefit from higher expectations for learning (Jorgensen, McSheehan, & Sonnenmeier, 2007). Though modifications are sometimes necessary, it is important to recognize the academic potential of each student as well as the importance of inclusion. It is expected that students on the autism spectrum are capable of learning academic skills related to grade level content that can enhance their lives (Browder et al., 2007). A foundational skill for learning academic content is engagement. This is a skill music therapy can address.

Students on the autism spectrum can present with more severe and more frequently-occurring challenging behaviors than their typically developing peers (Matson, Wilkins, & Macken, 2009). Not only can challenging behaviors hinder academic development, but these behaviors may impact relationship development with peers or, depending on the nature of the behavior, cause physical harm (Sigafoos, Arthur, & Riley, 2003) or impede active engagement in the classroom. All of these mentioned impacts affect progress in the classroom. Engagement is generally defined as time-on-task, time-on-schedule, and appropriate interaction (Carnahan, Basham & Musti –Rao, 2009). Individuals on the autism spectrum have difficulty displaying active engagement in learning states due to the core characteristics of autism (Bauminger-Zyiely,

2013). Each student has unique challenges and preferences in addition to his or her distinctive presentation of autistic symptoms.

It is generally accepted that individuals on the autism spectrum engage with visual presentation of material (Bauminger-Zviely, 2013; Grandin, 1996). As technology develops and integrates into daily life, researchers have also found a strong inclination for individuals on the autism spectrum to preferentially engage with electronic screens (Bernard-Opitz et al., 2001; Buggey, 2005; Charlop-Christy & Daneshvar, 2003; Schreibman & Whalen, 2000; Shane & Albert, 2008; Tissot & Evans, 2003) due to the natural characteristics. A concrete viewing area may encourage individuals on the autism spectrum to focus their attention to that stimuli. Manipulating the delivery of information through the screen may help individuals learn relevant information by increasing engagement to the information (Charlop-Christy & Daneshvar, 2003). Due to the tendency of individuals on the autism spectrum to avoid social stimulus (American Psychiatric Association, 2013) and the individualized manner that autism presents (Koegel et al., 2012), perhaps using a tool that is highly customizable might address engagement and challenging behaviors so that learning could take place.

Music therapy, like technology, is also highly individualized and an emerging treatment for individuals on the autism spectrum (Gold, 2014). Music performance alone can be a motivating activity (Lamont, 2012). Researchers suggest that simply adding music materials such as background music may not be enough to make improvements alone, but when grounded in evidence based methods, a motivating object can help facilitate improvements (Brownell, 2002; Kern & Aldridge, 2006; Kern, Wolery, & Aldridge, 2007). Music therapists apply music materials to treatment for many populations including autism spectrum disorder. Perhaps this evidenced-based therapy could provide structure to inherent motivating qualities of music. More

research on the impact of music as an instructional tool for students on the autism spectrum is needed (Geretsegger, Elefant, Mossler, & Gold, 2014). While there is ample literature investigating the integration of technology and autism treatment, there are limited data for the impact of the use of music therapy integrated with technology. Taking into consideration the core deficits of autism and how music therapy and technology independently can motivate children on the autism spectrum, in addition to facilitate treatment, the following research questions have been developed.

Research Questions

The intention of the current study is to replicate a study by Neely et al. (2013) which concluded delivering academic content through the use of an iPad® reduces children's challenging behaviors and increases engagement. One of the author's explanations infers the participants may have had aversive learned behaviors toward traditional materials. The use of the iPad® to present demands may have removed the establishing operation for the challenging behavior and authors note that more researchers should study this possibility through the comparison of non-traditional instructional methods to traditional methods. This study will explore this interest by comparing the impact of music materials, technology materials and the integration of music and technology materials and ask the following research questions.

1. Can the use of academic music therapy interventions have an effect on academic engagement?
2. Can iPad® use have an effect on academic engagement?
3. Can the integration of academic music therapy interventions and iPad® use have an effect on academic engagement?

CHAPTER 2: REVIEW OF LITERATURE

Technology is often used to improve the quality of life of many people with disabilities in some capacity. Researchers have investigated the use of technology interventions on the autism spectrum and the integrated use of music therapy and technology. However, no studies have examined the specific use of the iPad® integrated with a music therapy intervention addressing academics in autism. This chapter specifies previous literature that is imperative to this study. The information is presented as follows: (1) the diagnostic definition of autism spectrum disorder, how students on the autism spectrum are affected by current educational legislation, and how the core deficits of autism impact academics; (2) the use of technology with individuals on the autism spectrum; (3) the use of music therapy to address core deficits of autism; and (4) the integration of music therapy and technology as well as why the iPad® specifically may be favorable.

Autism and How Core Deficits Impact Learning

Autism Spectrum Disorder is a neurodevelopmental disorder that currently affects a number of individuals in the United States; approximately 1 in 68 children are affected according to current research (Center for Disease Control [CDC], 2014. There are several theories to consider as individuals of every race, ethnicity, and socioeconomic group are affected across a spectrum in severity with only recent statistics displaying slight patterns. Additionally, there is no known cure; therefore, individuals on the autism spectrum cope with challenges that others may take for granted.

According to the Diagnostic and Statistical Manual 5 [DSM-5], autism is defined by two larger categories of presented tendencies. The first being persistent deficits in social

communication and interaction, and the second is restricted and repetitive patterns of behavior, interests, or activities (APA, 2013). Deficits in social communication and interaction occur across multiple settings and may include current or historical presentations of deficits in social-emotional reciprocity (to include a lack of back and forth conversation or the inability to initiate or share interests, emotions and interactions), deficits in nonverbal communications (such as a lack of eye contact, body language, or facial expressions), and deficits in relationship development and understanding (specifically social rules, social coding, disinterest in peer relationships). The severity of these deficits varies from person to person. Restrictive and repetitive behavior patterns may manifest in stereotyped motor patterns, insistence on sameness, resistance to change, ritualized behavior patterns, fixated interests (typically to objects), intense focus, and sometimes hyper- or hypo- activity and interest in response to sensory input. The diagnosis is then specified if a co-occurring medical condition, language or intellectual impairment also exists (APA, 2013).

Academic Challenges. Intellectual or cognitive impairment in some capacity appears in the majority of individuals on the autism spectrum (Autism Speaks, 2012). The intellect of individuals on the autism spectrum may be poorly understood by standard intelligence assessments. This may be due to deficits in attention and language. A child on the autism spectrum or even a neuro-typical child may exhibit problem-solving skills that exceed assessment results, which may be difficult to demonstrate due to the child's impaired language abilities (Autism Speaks, 2012). It is also likely that many academic skills are poorly understood and addressed due to other core deficits of autism and co-occurring difficulties such as anxiety, stress, sensory processing, and physical or medical issues (Autism Speaks, 2012). Though cognitive impairment is fairly common among individuals on the autism spectrum, a large

number of children on the autism spectrum may be judged as low functioning through conventional assessments of cognition. This places individuals at risk for having unrecognized potential (Courchesne, Meilleur, Poulin-Lord, Dawson, & Soulieres, 2015). These above-mentioned matters highlight why it is paramount to research interventions that foster intellect in individuals on the autism spectrum while making considerations for inherent challenges. One of the primary environments for learning outside the home for children on the autism spectrum is schools. To ensure the rights of all individuals with disabilities in schools The Individuals with Disabilities Education Act (IDEA) was passed by the U.S. Congress in 1990. This legislation is important to students in special education as it impacts an important learning environment other than the home.

IDEA was enacted in 1990 and reauthorized in 2004. This legislation specifically addresses needs of students with disabilities. IDEA is based on a law passed in 1975 public law titled "Education for All Handicapped Children Act." (Education for All Handicapped Children Act, 1975). Important points from IDEA include that states must continue to provide free and appropriate public education (FAPE) at public expense in the least restrictive environment (LRE) while meeting the standards of the state education agency. Education of individuals with disabilities must be supervised and directed publicly and without charge to the individual. The student must be provided an appropriate preschool, elementary school and secondary school to attend in agreement with the individualized education plan (IEP) or the individualized family service plan (IFSP), depending on age, developed for the student (Individuals with Disabilities Education Act, 2004). These requirements are integral for education advocacy for all learners in special education programs including those individuals on the spectrum. The IEP documentation is one of the principal pieces of a child's special education. Schools must provide services

dictated on the IEP. If a parent does not feel the IEP is appropriate for the child, he or she is entitled due process to appeal and resolve necessary issues. Because of IDEA, all students with a disability have rights to education and the means to provide it. This is important information for music therapists to be aware of as often music therapists directly address academic skills or skills to help children on the spectrum in the school environment. It is also important to be competent in knowledge of challenges individuals on the spectrum face and how those challenges specifically impact academics.

Communication Challenges. Students on the autism spectrum can struggle in school settings due to communication impairments, difficulty developing social relationships with their peers and teachers, challenging behaviors, or sometimes a combination of all three (Koegel et al., 2012). However, despite these significant difficulties, current federal policy requires the progress of students is academic in content with the aforementioned grade level information as the point of reference (Koegel et al., 2012). Conventional assessments created without students on the autism spectrum in mind are unlikely to show accurate representations of the student's intellect; but even tests that are generally considered somewhat appropriate for even a nonverbal child require certain neuro-typical abilities, for example the ability to reliably point, which may be difficult for the students on the spectrum (Kasari, Brady, Lord, & Tager-Flusberg, 2013). It is paramount to create assessments with individuals on the autism spectrum in mind, and furthermore to design treatment and interventions with considerations for the core deficits of autism that may impact learning.

As abovementioned the DSM-5 identifies two primary deficit areas in autism spectrum disorder: impairments in social communication and repetitive, restrictive behavior patterns. Social communication deficits can largely impact a student's ability to learn due to impairments

in joint attention, social engagement, or specific speech and language deficits (Adamson, Deckner, & Bakeman, 2010).

Sharing attention, also known as joint attention, is largely recognized as a consistent deficit in individuals on the autism spectrum that presents early (Adamson, Deckner & Bakeman, 2010). Infants use joint attention early in life to communicate by utilizing both forms, responding and initiating. Infants also learn to initiate joint attention to make requests and learn cause and effect through reinforcement. Throughout typical development, joint attention develops and matures to a level allowing more complex and efficient learning to occur when the child enters school. Consequently, if a child does not develop joint attention, the deficit does not disappear with age. Children of school age who lack joint attention skills may initiate and maintain fewer interactions through fewer exchanges of communication (Jones & Schwartz, 2009). This skill is an essential skill for learning states (Jones & Carr, 2004; Mundy, 2007) specifically because the student must attend to what the teacher is attending to. In addition to the ability to engage and exercise shared attention to objects in the classroom such as a whiteboard, computer or text, students must also exercise joint attention to a social stimulus, the teacher, for academic information.

Further described by Kern (2012), children on the autism spectrum exhibit both expressive and receptive language challenges that result in a range of no functional communication to completely proficient language skills. A survey conducted among school speech-language pathologists (SLP) found that 98.8% of SLPs work was with a child on the autism spectrum (Plumb & Pleixco, 2013). Not only is the student specifically targeting speech and language, but seeing an SLP during his or her school day implies they are missing a portion of the school day, possibly academic instruction, that his or her peers are not. It is difficult to pinpoint exactly what

communication deficits an individual on the autism spectrum copes with during school. Many have difficulty expressing wants and needs, following verbal directions, in addition to initiating and responding to questions (Kern, 2012). These are fundamental skills in the classroom and may directly impact a student's ability to then produce speech to answer questions, initiate raising his or her hand, or receive a direction to remain in his or her seat, among other common classroom rules. The majority of teachers deliver information to their classes predominantly through verbal instruction, not just academic content, but also instructions containing complex multi-step directions, routines, social rules and expectations for participating throughout the school day. Due to the above-mentioned deficits in receptive language skills, this method of verbal delivery is ineffective for students on the autism spectrum (Carnahan, Musti-Rao, & Bailey, 2009). Besides expressive and receptive communication, individuals on the autism spectrum may struggle with other dimensions of communication. As above mentioned in the DSM-5 (APA, 2013), individuals on the autism spectrum specifically have difficulty with social communication.

Accompanying possible challenges with speech production, students on the autism spectrum may lack understanding of conventional nonverbal communication behaviors to include: eye gaze, use of facial expression, body position and gestures that supplement verbal communication (APA, 2013). Students in classrooms are encouraged and expected to work with peers in groups or partners at a young age where a large portion of learning occurs. Furthermore, all students are exposed to social rules and routines throughout the school day to include sharing materials, playing at recess, waiting in lines or sitting in groups for meals. These moments also provide opportunities for social flexibility and peer-to-peer learning. Depending on the student, a child on the autism spectrum might need more support during these experiences. It is difficult

for a teacher to dedicate enough quality time to facilitate with each student on the autism spectrum disorder relating to his or her peers. Other factors of overall social communication may contribute to learning. In order to communicate there must also be a foundational ability to social engage present.

Engagement is defined as complete absorption in a task or subject (Lamont, 2012). Attending to an instructor requires interaction among engagement, sharing attention and attending to social stimuli. Contributing to an individual on the spectrum's lack of social engagement may be affected by the strategy they use to interpret faces. The ability to discern important information from a person's face begins early in life development and is integral to peer relations (Hernandez et al., 2009). Hernandez et al. (2009) compared the visual scan path of a person on the spectrum and neurotypical individual and found that there are definitely differences in the way a person on the spectrum processes a face. A typical person engages mainly with the eyes and mouth, features that are the most informative. A person on the autism spectrum however may attend to seemingly irrelevant features of the face, perhaps an eyebrow or corner of the face. Of the three areas of interest, the participants on the spectrum did engage with the mouth the most. However, participants on the spectrum spent less time than typical peers looking at the eyes, mouth and nose as well as more time in the face background or off the screen (Hernandez et al., 2009).

This is consistent with research completed by Pelphrey and colleagues (2002). Researchers conducting this study also examined visual scan paths of faces to measure the facial regions that individuals on the spectrum attended to more frequently to see if that impacted the individual's interpretation of emotions. As in the Hernandez study, scan paths measured in typical participants formed a triangle to include the eyes, nose and mouth. Participants on the

spectrum's measured paths were more scattered and located toward the perimeter of the face. The amount of time participants on the autism spectrum engaged with the eyes, nose or mouth was significantly shorter than that of the typical group with longer amounts of time spent on the "off features." When asked to interpret emotions, participants on the autism spectrum scored almost 20 percent lower than the control group. Hutman, Chela, Gillespie-Lynch, & Sigman, (2012) also explored visual selective attention in infants on the autism spectrum in a study that compared selective attention to social (an examiner) versus non-social stimuli. The experiment was conducted in the context of play interactions and distress with infants on the autism spectrum, high risk for autism spectrum disorder, low risk for autism spectrum disorder and a group that was categorized as having other concerns, looking targets included the examiner's face, hand, the child's caregiver, a toy and other targets. Though the groups did not differ significantly from each other, the autism spectrum disorder groups looked to social targets the least.

Deficits in social communication can be present early and compound challenges in social understanding and the skills necessary to build on that, such as academic skills. The inability to engage with a social stimulus leaves a student on the autism spectrum disadvantaged in a typical classroom where information is largely presented from social stimuli. It is difficult to say exactly where the barrier exists for each person on the autism spectrum. The abovementioned research suggests that difficulty to visually engage may contribute to social understanding, but other research denotes additional difficulties that may also play a role. Kern (2012) explains difficulties with engagement due to social deficits listed in the DSM-5 (APA, 2013) further. Individuals on the spectrum show little interest in engaging with adults and peers. As a result,

they may not respond to distress and lack social reciprocity. Additionally, sharing attention, or joint attention, is largely recognized as a consistent deficit.

Attention Challenges. Joint attention is the uniquely human ability to share a common point of interest previous to spoken language (Mundy, 2007). This impairment is present early in individuals on the autism spectrum (Adamson, Deckner, & Bakeman, 2010). Infants use joint attention early in life to communicate by utilizing both forms, responding and initiating. Infants learn to initiate joint attention to make requests and learn cause and effect through reinforcement. Throughout typical development joint attention develops and matures to a level allowing more complex and efficient learning to occur when the child enters school. This skill is an essential skill for learning states (Mundy, 2007) specifically because the student must attend to what the teacher is attending to. This researcher also suggests without joint attention, success in the academic context is extremely difficult. Simply between a teacher and student, a teacher commands the "attention" of the student. Mundy proposes that this demand is more specifically for the student to attend to what the teacher is attending to. In addition, students must also attend to a social stimulus, the teacher, for academic information.

As previously stated this may be difficult due to a student on the autism spectrum's deficit in social communication. However, there may be other factors that compound challenges of attending to a teacher such as attention deficits. Attending to a peer or teacher requires a student on the spectrum to work through the challenge of attending to social stimuli (Ibanez et al., 2008; Swettenham et al., 1998) and rapidly shifting attention (Dawson et al., 1998). Transitions and shifting attention from competing stimuli are also a persistent deficit for individuals on the autism spectrum (Sanders, Johnson, Garavan, Gill, & Gallagher, 2008). Similar to above mentioned visual preferences, individuals on the autism spectrum have attention preferences as

well. Research by Swettenham (1998) concluded individuals on the autism spectrum prefer to focus on non-social stimuli. This researcher studied the allocation and planning of attention in infants on the autism spectrum between social and non-social stimuli. Attention was measured by eye gaze and eye gaze shift. When comparing all groups: autism, developmental delay and typical infants, all groups spent more time gazing at objects compared to social stimuli. However, the largest margin of time between social and non-social was found in the autism group.

These above-mentioned social communication difficulties and tendencies often lead to many challenges in the classroom for the student on the spectrum. Each student has his or her own individualized challenges he or she confronts, but are not limited to social and communication challenges. Often compounding social communication differences are behavior challenges.

Behavioral Challenges. Behavior challenges are manifested in many ways including restricted routines and patterns of interest, abnormal focus, insistence on sameness, distress from change and preoccupations with irrelevant parts of objects (Kern, 2012). These behaviors can easily interfere with a child's learning environment and thereby his or her optimal development (Armstrong et al., 2015; Brereton, Tonge, & Einfeld, 2006). These behaviors can present themselves in self-stimulatory behaviors (i.e. stereotypically flapping or rocking) but can also present itself in more discrete manners and are not limited to anxiety, obsessive compulsiveness, inattention, non-compliance and at times aggression (APA, 2013).

The most studied behaviors are stereotypy, self-injury and aggression (Horner, Carr, Strain, Todd, & Reed, 2002). These present in three categories: external (i.e. aggression or property destruction), internally maladaptive (self-injurious behaviors, stereotypy or pica) and

socially disruptive (disruption, inappropriate or unintentional verbalizations, noncompliance). It is reasonable to state that the presentation of one or combination of any of these behaviors directly results in affected academics when taking place in the classroom. Not only do behaviors take away time from academic instruction, but also impact peers and therefor exacerbate social struggles (Swaim & Morgan, 2001).

Behaviors can also present more subtly. In a review by Sanders et al., (2008) researchers found that individuals on the autism spectrum have intact sustained attention, but often to irrelevant stimuli, and have difficulty shifting attention back to the relevant stimulus. Though this can present internally or externally, this has large implications for how a student on the autism spectrum may behave in a classroom. For example, a student might show intense focus on an irrelevant stimulus during the school day. That stimulus might encourage the child to engage in a challenging behavior. The student may have extreme difficulty transitioning his or her focus away from what is causing them to engage in a challenging behavior. Additionally, challenges might then be intensified by the student's differences in communication and lack of social understanding. This example illustrates how important it is to understand the core deficits of autism and how the unique struggles of each individual interact.

Students are placed in a visually stimulating environment among peers that may provide competing auditory stimuli with the teacher's verbal directions. Although the sustained attention may contain the capacity to focus on academic information for duration of time, there are ample competing stimuli in a classroom. Examples might include other student's chatter, objects in the room and thoughts regarding things outside the classroom. Researchers are in agreement that negative behaviors are best decreased with behaviorally based interventions that build on the interest that motivates the child. The intervention should be engaging and taught through simple

steps and provide reinforcement of pro-social skills (Horner et al., 2002). To increase engagement, and therefore reduce the probability of challenging behaviors, it is necessary to provide students with on the autism spectrum with a stimulus that is the most interesting thing in a field of competing stimuli that they might naturally want to attend to. Perhaps that object could be a technology device.

The Use of Technology with Individuals on the Autism Spectrum

Technology is not a new tool being used to treat autism. As far back as 1984, Panyan gathered information about technology uses for individuals on the autism spectrum. Panyan produced sources into a literature review that specifically looked at advantages of the computer, core deficits of autism spectrum disorder and how the computer might complement treatment. Panyan cited Colby (1973) as well as an article by Goldberg (1979) that discussed the utilization of computer symbols to encourage communication in the review. These foundational explorations and experiments are necessary in order for researchers to ask more questions and refine the knowledge base.

Since these three publications, research has profoundly deepened in support of technology. There is now abundant research in support of using technology in some capacity to help individuals on the autism spectrum. One study focusing on communication (Kagohara et al., 2010) examined how to increase communication by teaching a 17-year-old male on the autism spectrum to use an iPod Touch® to request preferred foods. The participant utilized the app "Proloquo2Go™" to transform it into a speech-generating device. The participant was able to learn to use the device, but there were some errors navigating the interface. According to the researchers, the iPod touch® required somewhat of a specific touch to activate the speech output. Though refinement was necessary, the participant was able to learn the use the device. Another

similar communication study focused on teaching individuals on the autism spectrum to operate an iPod touch® using Proloquo2Go™ software (Achmadi et al., 2012). This study focused specifically on navigation of the device (i.e. turning it on, unlocking the screen, finding correct screen pages) and then utilizing the app to make requests. Both participants in this study were able to learn these steps in preparation for using the device as a speech generated device. A larger communication study, (Flores et al., 2012) involved five male participants on the autism spectrum (ages 8-11) comorbid with intellectual or multiple disabilities. The researchers replaced picture cards made with traditional paper materials with electronic picture cards displayed on an iPad®. Three of the five participants made more requests utilizing the iPad®.

In other recent studies researchers made direct comparisons of iPad® use to traditional systems (i.e. PECS or manual sign) for making requests (Kagohara, et al., 2012; van der Meer, Didden, et al., 2012; van der Meer, Sutherland, O'Reilly, Lancioni, & Sigafoos, 2012). Results were individualized and yielded varied results. However, in all three studies at least one participant, if not the majority, learned to use an iPod touch® or iPad® device as a speech generating device and was able to better maintain the learned skill with a device compared to a traditional system.

Other functional skill areas besides communication have successfully been addressed with iPads®, iPods® and other technology devices. Researchers have found the compact size and advanced features of the iPod with video capability to be useful in employment settings. In one study by van Laarhoven, van Laarhoven-Myles, Grider, and Grider (2009), the iPod® was utilized to convey instructions and prompt a 17-year-old individual to attend to task with video modeling. Given the four presented tasks (sweeping and mopping, cleaning a restroom, emptying garbage, and cleaning animal kennels), the individual's performance level stayed high

(89%) in follow up sessions. The participant's independence in task performance also increased as the need for prompting decreased after video use. In this employment context the use of the iPod® was effective in increasing task completion.

Video modeling has also been used successfully to address social communication skills in the classroom setting in individuals on the autism spectrum. Hart and Whalon (2012) investigated the use of self-video modeling to address academic responding (initiating spontaneous responses to academic questions) for an adolescent on the autism spectrum. The video allowed the individual to use himself as a model and repeat the video as necessary immediately before his class. It also provided a discrete and easy-to-use platform for prompting. The individual that participated in this study was high school aged, but social skills can also be addressed earlier in childhood as well. A commonly recognized intervention for early childhood addressing social skills with persons on the autism spectrum is social stories. Social stories are also highly adaptable with the use of technology.

Mancil, Haydon, and Whitby (2009) examined the effects of social story presentation on inappropriate behaviors in three children on the autism spectrum. One presentation utilized paper social stories and the other was computer assisted using Microsoft PowerPoint. The PowerPoint stories yielded only slightly better results; however, the students reported preference for the PowerPoint stories. This study pointed out that attention preference and willingness to engage may be important factors in improving social skills. Attention and engagement can also be directly addressed with technology. This has been specifically focused on in research regarding technology.

Engagement is a vital factor in learning functional skills. Mineo, Ziegler, Gill and Salkin (2009) specifically investigated whether students on the autism spectrum would attend better to

an electronic screen in a classroom environment. While numerous anecdotes conclude individuals on the autism spectrum are captivated by videos and tend to be visually oriented, there is little empirical evidence (Mineo et al., 2009). Forty-two participants on the autism spectrum were investigated for engagement patterns. Engagement was measured in terms of vocalization (discrete verbalizations during video play) and eye gaze (percentage of time eye gaze was spent looking toward the screen during video play). Four conditions were presented: a control (a two minute clip from the movie Mary Poppins©), self-video (customized clip of the individual engaged in a task), a video of a familiar person while engaged with a virtual reality game and engagement of self in the virtual reality game. The data revealed preferences for the participants for seeing themselves on screen and viewing the virtual reality scenarios. The authors provided extensive information regarding the profiles of participants and individualized intervention stimuli per participant. This background information has implications for the results reflected in the data. Relative engagement was difficult to define but the study, since it was the first study of its kind, but the study provided the groundwork for more work for research examining the relationships between characteristics of technology and participants. Also, though overwhelming results were not necessarily identified in this study, it was critically designed and detailed to provide an important step forward in researching technology and engagement.

Cardon and Tamiko (2012) published a study examining the effects of technology on engagement. The study compared typically developing children and children with autism when presented puppet shows live and in video format shown on an iPad®. When presented information in a video versus live modality, Cardon and Tamiko concluded students on the autism spectrum preferred video delivery. All students attended to the shows for longer periods of time when video delivery was utilized. The results supported that children on the autism

spectrum may have a preference for video presentation and that presentation may impact the duration of visual attention. Due to the importance of engagement in the school setting this information may also have implications that directly impact academics.

Moore and Calvert (2000) directly addressed the effects of technology on academics in a study that analyzed vocabulary acquisition. The researchers compared teacher versus computer based instruction. Besides learning more vocabulary with the computer instruction, it was noticed the children were more attentive and more motivated to learn. Though the task was academic in nature, it appeared attention to task and motivation played an important role.

These above mentioned research explorations provide important initiatives for treatment and adaptations for individuals on the autism spectrum. Though these investigations looked critically at the effects of technology and made important gains for the growing body of research, the amount of empirical data for technology use for persons on the autism spectrum is still considered low (Pennington, 2010). Parents and teachers are encouraged to exercise extreme caution when using technology with all students which may perpetuate a fear of technology by some individuals (Richtel, 2010). Though parents and teachers should indeed take caution when implementing any new treatment or education method with children, it is historically true that any advance in technology raises various concerns, even the high speed train or telephone (Heitner, 2014). Technology may be safely used as a motivation object if carefully implemented. Researchers have dictated that any motivating object should be grounded in evidenced based behavioral methods to make effective and lasting change (Cardon & Azuma, 2012).

Due to the individualized nature of technology, specifically the iPad®, it is possible that the highly motivating characteristics of the iPad® paired with evidenced based behavioral

methods may be able to add to effective treatment methods for individuals on the autism spectrum. Logistically the iPad® is a feasible piece of technology to be used as evidenced by its increased abovementioned use in many settings, including schools. It is portable, has an appropriate screen size, is widely accepted without stigma, has the ability to enlarge and reduce screen images, and can be customized in various ways to address individual needs and goal areas (Kagohara et al., 2012; Neely et al., 2013). The iPad® provides a concrete and tangible object that students on the autism spectrum can appropriately and naturally sustain their attention to.

The iPad® may provide countless opportunities for all students. If its use is executed with empirically validated educational and behavioral paradigms, it is possible that using an object that is motivating, preferred by the student, and individualized to a student's strengths and needs can enhance the students learning. Providing a novel, interesting and motivating stimulus may enhance treatment. Technology may provide an inherent interest for visual attention. Furthermore, due to its portability, perhaps the use of the iPad® can then enhance other evidence based treatment methods that are equally as motivating and individualized. An emerging treatment modality for autism that is motivating, novel and individualized is music therapy.

The Use of Behavioral Based Music Therapy Interventions

Music performance alone can be a motivating activity (Lamont, 2012). Motivating objects are defined as: "events that alter the value of reinforcement and the frequency of behavior previously correlated with such reinforcement" (Rispoli et al., 2011). In other words, an object or experience behavior that is highly valuable to the individual is used to encourage a desired behavior. Motivation is often individualized to the person. Researchers specifically examined the effect on motivating objects on two children on the autism spectrum (Rispoli et al.,

2011). By simply incorporating pre-session exposure to a motivating object, both children demonstrated lower levels of problem behaviors and higher levels of academic engagement.

Motivation is important piece of music performance and music therapy. Performing music involves activation of hedonic and eudaimonic centers, or means of pleasure and happiness (Lamont, 2012). Hedonism is considered the presence of positive affect and the absence of negative affect. Eudaimonism can be further broken down into two parts: engagement and meaning. That is, satisfaction with life experiences often involve the individual feeling captivated in a given task that is meaningful to him or her. While the goal of music therapy is not the same as music performance, a client may actively engage in music experiences the way he or she might if performing music. If that person is motivated by music, music can provide a continuous motivating stimulus to encourage positive behavior.

Motivation is described as an integral component of music therapy interventions (Merrett, Peretz, & Wilson, 2014). In addition to research on increasing affect during music performance, research done by Blood and Zatorre (2001), Menon and Levitin (2005), and Salimpoor, Benovoy, Larcher, Dagher, and Zatorre (2011) provided evidence for increasing positive affect during music listening. The activation of brain routes for reward and motivation centers advocate for the use of music to motivate humans for neuroplasticity and task completion.

Music therapists see first-hand that clients are motivated by engaging in music interventions. The nature of a music therapy interventions can optimize the encouragement of positive behavior and discouraging negative behaviors. Music provides an increase in dopaminergic neurons, synchronization of neural firing and a clear signal among a field of competing stimuli (Stegemöller, 2014).

Dopaminergic regions of the brain are responsible for motivation, reward seeking (Dayan & Balleine, 2002; Morita, Morishima, Sakai, & Kawaugchi, 2013; Salamone & Correa, 2002) memory (Sawaguchi & Goldman-Rakic, 1991) and learning (Montague, Dayan, & Sejnowski, 1996; Wise, 2004). When these regions are activated, an enhanced learning environment is created. It is also important to note that dopaminergic firing is capable of transferring from the reward itself to the cue (Romo & Schultz, 1990). Paired sensory stimuli (music) and stimulated dopamine regions have been shown to result in cortical remapping (Schultz, 1992). In the case of a music therapy intervention, a client may be prompted with an auditory cue to complete a non music task during learning. Music facilitates a dopaminergic response that can potentially be transferred from the original music cue to the task itself. During dopaminergic firing a process known as long term potentiation (LTP) occurs that enhances synaptic connectivity which lasts for weeks (Bliss & Lømo, 1973; Gurden, Takita, & Jay, 2000; Otmakhova & Lisman, 1998). This strengthening of synaptic connections is mediated by dopamine, which is activated by music cues. The repetitive nature of music can inherently facilitate repetition and practice of this process. As the dopamine response transfers from the music to the new task and a new behavior is learned.

Motivation provided by music also allows for synchrony and organization of neural networks to occur. Music is inherently inclusive of rhythm; while engaging in music an individual is also engaging in rhythmic activity. Rhythm facilitates a process known as entrainment (Rosenblum & Pikovsky, 2003). Movement, vocalization, respiration, and heart rate can all be entrained to music (Miendlarzewska & Trost, 2013; Müller & Lindenberg, 2011). In addition to these responses, neural populations can also be entrained and researchers also suggest entrainment has an impact an attentional resource (Gander, Bosnyak, & Roberts, 2010; Müller &

Lindenberg, 2011). If rhythm within music can organize the abovementioned processes it is reasonable to suggest that pairing a non musical task with music can provide synchrony and organization of neural networks to encourage task completion (Stegemöller, 2014).

Music can also provide a concrete signal of what a desired task is for individuals with brains that have difficulty processing verbal information. This skill as earlier mentioned is difficult (Carnahan, Musti-Rao, & Bailey, 2009). In fact, auditory "noise" can increase stress and may have long-term impacts on cognition and memory (Amemiya, et al., 2010; Hirano, et al., 2006; Kraus & Canlon, 2012) and suppress LTP (Lynch, 2004). However, long term exposure to music can lead to specific improvements in spatial learning and enhanced learning performance. The acoustic signal of song is more consonant than speech. Researchers were able to demonstrate this phenomenon by showing that professional musicians have less "noise" signals in their brains when exposed to both spoken and sung signals. Knowing this perhaps music therapists may be able to minimize "noise," and therefore reduce interfering stress, in their vocal signal when presenting information. Sung information is clearer and more easily encoded than spoken information.

Increased dopaminergic responses, organization of neural firing and production of clearer signals occur naturally and simultaneously during music engagement and listening (Stegemöller, 2014). These reactions facilitate motivation, engagement and learning in a way that addresses core deficits of autism spectrum disorder. Music therapists are able to manipulate music to enhance neural responses that direct client behavior. The inherent structure of music therapy has lead to promising research addressing difficulties faced by individuals on the autism spectrum.

Music therapy is an evidenced based practice that incorporates structure, creativity and individualization with a growing body of research to substantiate its use with individuals on the

autism spectrum. Numerous studies provide evidence for music therapy as effective treatment for individuals on the autism spectrum of varying ages. In young children, music therapy can facilitate communication, interpersonal skills, personal responsibility and play (Whipple, 2012). Emotional identification and expression have also been successfully addressed (Katagiri, 2009) accompanying cognitive skills such as joint attention, memory and visual recall (Kalas, 2012) as well as auditory processing, sensory, perceptual or fine and gross motor skills (LaGasse & Hardy, 2013). These researchers have added to foundational research for the ability of music therapy to effectively address various goal areas to help individuals on the autism spectrum.

Researchers have also examined music therapy regarding its successful integration with other therapeutic approaches. Thompson, McFerran, and Gold (2013) conducted a study that examined the increase of social engagement in the home with music therapy interventions rooted in family centered practice. Brownell demonstrated this adaptability in a study that demonstrates social stories adapted to music and used in music therapy interventions to address behavior and teach new skills (Brownell, 2002). These studies validate that music therapy is flexible and enhance success when paired with other evidence based practices.

The most recent Cochrane review regarding autism (Geretsegger , Elefant, Mossler, & Gold, 2014) examined ten music therapy randomized control studies working with one hundred sixty five participants on the spectrum. In comparison to a placebo or standard care control variable, music therapy was considered superior, addressing primary outcomes under social interaction within therapy, generalized social interaction, non-verbal communication skills within therapy, verbal communication skills, initiation of behavior and social-emotional reciprocity. In secondary goal areas such as social adaptation, increasing positive affect and parent child relationship quality, music therapy was also considered superior to a placebo or

standard care control with low to moderate quality evidence (small sample sizes and design). Though there is promising evidence for both the use of music therapy with persons on the spectrum and the use of the iPad®, little evidence exists for the combination.

The knowledge that active participation in music provides increased positive affect (Blood & Zatorre, 2001) and increases energy also supports that music can motivate an individual to participate in a task. The motivation to initially participate provides a place for a student to prepare for learning. This information combined with the student's preference to attend to technology (Mancil et. al., 2009) could have implications for careful implementation of interventions that incorporate technology and music therapy.

Music Therapy and Technology Combined

Though the use of technology is not new or uncommon in music therapy, its use in therapy application is not yet as thoroughly researched. Some of the earliest research on music therapy and technology dates back to an article review of a program called "Musicshapes" (Krout, 1989). Krout described the pricing, procedure, and applications of the software. Most of the article focused on the various features and screens but in summary Krout stated the program requires the assistance of the therapist and the program itself is nonthreatening and an exciting tool to motivate music therapy clients.

Simpson and Keen (2010) used song to teach graphic symbols to children on the autism spectrum. These researchers used music to teach communication skills in three young boys on the autism spectrum. Though the study set out to examine song specifically, it included a technology element. An interactive whiteboard and PowerPoint® presentation was used with the intent of the technology to minimize researcher bias when delivering the music. Though there was little generalization of communication skills, this study utilized the combination of musical

and technological delivery of material. The researchers acknowledged that without a condition that isolates the use of music (without technology use) it is difficult to say to what degree did the technology impact learning. Conceivably though, combining two highly motivating objects could be beneficial. More studies that isolate these two means and examine the combination are needed.

Knight and LaGasse (2012) conceptually focused on technology in music therapy. The authors reviewed several technology devices and suggested not one type of music is supreme but rather what the client prefers, even if presented through technological means. Given how important motivation is when pairing with a non musical task, music therapists should consider technology for delivery when presenting music stimuli.

Though music therapists do use music technology in sessions to benefit clients, there are some reservations for its use. A commentary by Nagler (2011) explored reservations of therapists and why music therapists may not be apt for using technology in sessions. Nagler observed both in the U.S. and Europe music therapists have a "troubled history for embracing music technology" (2011). He suggested that music therapists should consider the possibilities of technology use, but carefully so while remaining genuine to evidence based practice.

Nagler (2011) is not the only researcher to notice a reticence from music therapists toward technology use in clinical practice. Two surveys were conducted within the last decade on music therapist's use of technology. The barrier that stood out the most among the results was that therapists felt they were not educated enough in the use of devices (Hahna, Hadley, Miller, & Bonaventura, 2012; Magee, 2006). This echoes the need for research that implements clinical applications of technology and music therapy. More research could lead to more accessible knowledge for music therapists to educate themselves on effective and relevant tools.

Music therapists identify lack of education as a prominent hindrance in using technology in sessions. The iPad® is a single device that a music therapist could use to benefit clients. For therapists insecure about their education on technology, perhaps the iPad® is a feasible piece of technology for a music therapist to familiarize him or herself with due to its user-friendly nature and adaptability. It is also a feasible piece of technology for music therapy interventions for the same reasons it is feasible for the client: portability, ability to become individualized, size and simplistic design. Use of the iPad® requires a smaller knowledge base.

While the iPad® may provide novelty and motivation for clients it is important to note its use is not therapy in itself. Research by Kagohara et al. (2012) examined a number of successful studies utilizing technology and found that most incorporated principles of applied behavioral analysis (Duker et al., 2004). Kagohara et al. (2012) cautiously concluded that hand-held technology devices, such as the iPad®, iPod® etc, can be a feasible tool when carefully implemented in structured behavioral methods. Another consideration is the individual's interests.

Similarly, research by Kern, Wolery and Aldridge (2007) suggested that interventions that integrate an individual's interests, in addition to researched-based interventions such as routines, structure or social stories, may increase results for individuals on the spectrum. It seems reasonable to combine the use of the iPad® and music therapy. Both provide flexibility and customization to address needs of individuals on the autism spectrum. For example, if a student has difficulty with processing abstract language and following directions, music can provide a clear signal of easily encoded information to the brain and the iPad® can provide a concrete location for the response. This device may also help facilitate a student on the spectrum who has difficulty responding to questions communicate. Music can provide the structure of a

reciprocal conversation and the iPad® could generate speech for answers. For a student who may have difficulty socially engaging with others and prefers engaging with objects, music can create a motivating and enhanced learning environment (as previously discussed by activating dopaminergic receptors in the brain) and the iPad®, an object, can be customized to delivery important information for learning. Both the use of music and the iPad® can be gradually faded to facilitate independence and goal achievement.

Due to the individualized nature of technology and specifically the iPad® it is possible that the highly motivating characteristics of the iPad® paired with evidenced based behavioral methods may be able to add to effective treatment methods for individuals on the autism spectrum. The iPad® with its versatility can effectively address the student on the autism spectrum most salient need whether it be teaching pro social behaviors through modeling, motivating students to complete non-preferred tasks, or prompting students all while engaging them to a preferred stimuli (Charlop-Christy & Daneshvar, 2003; Hutman et al., 2012; Neely et al., 2013; Rispoli et al., 2011). The feasibility of the iPad® is also demonstrated by its prevalence in schools with an estimated 13 million sold to K-12 schools and higher education settings as reported by Apple's quarter report in the 2014 fiscal year (Dowling, 2014). Of tablets being utilized in K-12 schools, the iPad® takes up about 94% of the market (Cavanagh, 2014).

Various researchers acknowledge the frequent use the iPad® with individuals on the autism spectrum due to its portability, provided sense of independence, ability to be customized, simple design, touch screen and large screen size (Shah, 2011). The iPad® is also a concrete and tangible object which may help students on the spectrum who have difficulty processing abstract concepts (APA, 2013). This concrete object, which may also be a visual preference (Mineo et al., 2009), can be manipulated to facilitate learning due to its ability to support the student

despite their deficits and capitalize on the strengths of the student's intense sustained attention (Sanders, Johnson, Garavan, Gill, & Gallagher, 2008). Increased engagement to a motivating object leads to reductions in challenging behaviors and can then further learning (M. Rispoli et al., 2011). A study by Neely et al. (2013) yielded positive results when addressing academic skills with the use of an iPad® simply replacing traditional materials, i.e. paper and pencil. Results also indicated decreased challenging behaviors. To increase the power of the iPad®, more research in varying settings is necessary. Perhaps this setting could be a music therapy session.

One article by Knight (2013) provided a review with suggestions for iPad® usage specifically within the context of music therapy. This resource provides important foundational work for technology use, including the iPad®, to increase in music therapy. While research for music therapy technology is developing, there are still large gaps between publications and feasible, clinical applications. Important themes continue to appear in research, but research with clinical applications and specific procedural details would benefit the field.

The current study will model research by Neely et al. (2013). This study will expand the findings to determine how engaging the iPad® might be by providing a different context and working with additional participants with varying goals. This research may provide implications for how music therapists may incorporate the iPad® into music therapy sessions, as well as build support for research that suggests the iPad® is highly engaging for individuals on the autism spectrum.

CHAPTER THREE: METHODS

Participants

Two individuals on the spectrum were recruited from a convenience sample to participate in the current study. Children had a prior diagnosis from a physician based on presented characteristics of autism as defined by the American Psychiatric Association (APA; 2013) including prominent deficits in social communication and restrictive and repetitive patterns of behaviors and interests. Participants were identified by facility staff due to history of resistance to completing academic tasks, engaging in challenging behaviors, and off task behavior. To reduce confounds potential participants with any other diagnosis other than autism were excluded from consideration. Approval was obtained from the Colorado State University Institutional Review Board for the protection of human subjects in order for children to participate.

J is a 13-year-old male diagnosed with autism spectrum disorder in 6th grade living in central Indiana with his family. J attends public school in a general education classroom with an aid and some special education support in an autism classroom. J receives approximately 15 hours of applied behavior analysis therapy weekly. J met the inclusion criteria and was identified for the study because he presented with challenging behaviors to include verbal protesting, avoidance, wandering and attempting to leave appropriate areas and picking (picking at himself, his clothing, furniture, or small objects) while working on academic tasks. J verbally communicated while performing the task. The room contained a large task, instruments, and table space for working. J sat on a therapy ball for treatment similar to his regular music therapy sessions. Only the music therapist and J were present for treatment. The targeted academic task J worked on for the study was memorizing multiplication tables (factors zero through twelve).

The iPad® is present in several settings for J. J utilizes an iPad® at home for reinforcement and leisure, at school for academic tasks, and in music therapy for reinforcement and music interventions.

A is a 12-year-old female diagnosed with autism spectrum disorder. A is in 6th grade living in central Indiana with her family. She attends a public school in a general education classroom. A attends in school speech therapy and works with an aid in the classroom. A uses an age appropriate vocabulary to communicate verbally. A met the inclusion criteria and was identified for the study because she displayed verbal protesting, wandering and attempting to leave appropriate areas to avoid a task, and general avoidance when working on academic demands. A utilized an iPad® at home for reinforcement and leisure, at school for academic tasks and in music therapy for music interventions. For A's treatment was held in the typical music therapy location, only the therapist and A were in the room. The targeted academic task A worked on was elapsed time exercises (calculating the time passed given two times of day).

Experimental Design and Variables

In order to best determine which materials impact engagement during a music therapy intervention and an iPad® intervention was tested in addition to the integration of the iPad® with music therapy intervention. A single case, multiple treatments design was used in this study (AABCDBCD), where A denotes traditional materials, B denotes music therapy intervention, C denotes iPad® materials, and D represents the combination of a music therapy intervention and iPad® materials. The rationale of this design was to illustrate how the participants might perform differently due to the differences in the experimental conditions. Continuous assessment from multiple observers allows for inference of causation. In single case design data clearly show varying outcome levels if there is perception of preference among multiple

conditions. If performance differs considerably as a function of the different treatment conditions, a functional relationship may be suggested between the experimental conditions and performance (Kazdin, 2010). Raw scores were graphed for comparison to determine if there is a relationship between any of the experimental conditions and increased engagement. Participants were presented conditions in a randomized order (randomized using a computer) following traditional materials (table 1).

The dependent variable remained the same throughout conditions: academic engagement. Academic engagement was be defined as time looking at materials, on task response to gestures and prompts, on topic verbalizations and the length of time participants do not engage in challenging behaviors (Neely et al., 2013). The independent variables for researcher questions 1, 2, and 3 was defined as academic music therapy intervention, iPad® use and the iPad® integrated music therapy intervention respectively. To explore the final research question data from conditions B and D were compared.

Materials and Setting

Treatment took place in the researcher's music therapy clinic with appropriate seating and table space for working. Individualized specifications to the room (e.g. curtains over windows and shelves, dimmed lighting, white noise, chair or yoga ball) were used per what is standard for each participant's regular music therapy session. Each participant attended two sessions per week for a total of four weeks allowing each treatment to be tested on two days. Traditional materials materials for J included paper multiplication flashcards. Participant A utilized paper worksheets, a pencil, and scratch paper. Music therapy materials included an accoustic guitar and singing cues to facilitate and prompt. The iPad® materials used for Participant J was flashcards displayed through the iPad® application "Study Blue." The iPad®

materials for Participant A used the app "Notability." The app displayed the elapsed time worksheets and had room for scratch work within the interface. Participant A wrote answers and scratch work using her finger.

Procedures

Before implementing the experiment this researcher consulted with each participant's parents to define the appropriate academic demand for the experiment. Multiplication facts (times tables with factors from zero to twelve) and simple elapsed time exercises (calculating time passed given two time of day) were chose as the outcome of consultation with parents. These tasks also coincided with the study in replication (Neely et al., 2013) to follow this criterion: the task will be a demand that could be performed by the participant, has been previously mastered but is inclined to bring out signs of a state of being unengaged. Treatment conditions were presented in a balanced randomized order to control for learning effects.

Participants were seen twice per week. Each session contained four trials lasting five minutes with a two minute break in between each trial. The researcher will present the demand using least-to-most prompting (verbal prompt, verbal and gestural combined prompt, and physical prompt) to achieve the academic task. The researcher utilized the phrase "time to work" as the initial verbal prompt and continued the prompt sequence noted if necessary. Once the participant achieved the academic demand the researcher will provide verbal praise no matter the prompt level. If the participant displayed any challenging behaviors the participant was verbally or musically redirected to the task depending on the condition. If the participant gave a wrong answer, he or she was corrected to avoid overlearning incorrect answers.

For participant J, the only distinction between conditions was the display of the math materials and the use of musical cuing. In condition A (baseline), J was presented with black

and white multiplication flashcards spanning factors zero through twelve (appendix A). J was given the verbal direction "time to work." J was shown each card paired with the researcher verbally reading each problem. If J did not know the answer, he was directed to ask the researcher for the correct answer ("What is 4 times 4?") in response to the researcher's cue "let's check it." The problem was repeated as a statement with the answer. This expectation was the same throughout conditions. J also independently manipulated the flashcards into complete and incomplete piles. During condition B, the only distinction between the music therapy condition and the baseline condition was the use of musical cueing provided from the resarcher. The music selected was original music composed by the researcher. The researcher utilized a guitar and sang a repetitive jingle to provide structure and cue J to complete problems (appendix B). If needed rhythmic strumming prompted counting to find the answer to a problem (appendix B). J continued to manipulate the paper flashcards into complete and incomplete piles. During condition C, the musical cuing was removed and J utilized the iPad application "Study Blue" for delivery of problems (appendix C). The problems were pre-loaded into a set of iPad flaschards. J independently operated the application which included touching the card for the next problem and a thumbs up or down to indicate incorrect or correct. During condition D, musical cuing was re introduced and combined with the "Study Blue" application. The same jingle and chord progression from condition B was used.

For participant A, the baseline condition used paper elapsed time worksheets (appendix A) and a traditional pencil. A was give the verbal direction, "time to work" and verbally read reach problem. The problems were of varying difficulty spanning from nearest hour, nearest half hour, nearest quarter hour, nearest five minutes within and across AM and PM. During condition B a music therapy intervention targeted sustained engagement on the task with the only

distinction being the addition of music cues. A short and repetitive jingle facilitated participant A to continue working on the worksheet. Singing and a guitar was primarily used to cue A. Each problem was sung over a harmonically open music phrase and progression that was completed upon completion of the problem (appendix B). If needed rhythmic strumming cued redirection back to the problem, counting out loud to find an answer and writing tallies to find an answer. During condition C, music cueing was removed and the content was delivered within the iPad® app "Notability" (appendix C). The worksheet and scratch space for working were pre loaded and participant A wrote on the screen with her finger. A independently operated the application. During condition D, the music cues were combined with the use of the "Notability" application. The combination was the only distinction between condition C and D was the same application and same music cues and jingle were utilized.

Table 1.

Randomized schedule of conditions for treatment phase.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
Participant								
J	A	A	D	B	C	D	B	C
A	A	A	D	C	B	C	B	D

Note. A denotes traditional materials (baseline), B denotes music therapy materials, C denotes iPad® materials and D denotes the integration of music therapy and the iPad®.

Data Collection & Analysis

Data were collected on the percentage of intervals of displayed engagement time using ten second partial interval recording. Engagement to task was defined as looking at the assignment and task materials, responding to questions verbally or physical demonstration, participation without challenging behaviors, and verbalizing with researcher in conversation directly related to the demand. Data collected per interval were calculated into a percentage

score. Challenging behaviors per participant were specifically operationalized (table 2) and displayed graphically. The principal method of data analysis was visual analyses. Graphs were used to display the course of the baseline and intervention phases over time. A frequency table showing raw scores depicts each scores for each interval (figures 1-8). Mean scores were calculated per condition and are displayed graphically to observe trends between conditions (figures 9 and 10). Mean scores per measure of engagement are displayed to determine if there are any differences in treatment on looking at appropriate materials, responding to the therapist, challenging behaviors or on topic verbalizations (figures 11 and 12). Sessions were video taped to for observers to mark whether or not a behavior occurred using data collection forms (appendix F). Data were coded using Microsoft Excel®. In the same program inter rater reliabilty was calculated with a Pearson Product Moment correlation to determine if there was any relationship between the two observers.

Table 2.

Challenging behaviors defined per participant

Participant	Avoidance	Verbal protesting	Other behaviors
A	leaving chair, attempting to leave room, extreme focus on materials not related to task, doodling.	excessive off topic verbalizations, requests to stop, requests for other activities and items, repeated questions, complaining about task, excessively singing irrelevant songs.	Refusal to complete task
J	leaving chair, wandering within room, inappropriately sitting in chair to move away from task.	requests for other activities, requests to stop, scripted phrases ("I don't remember"), shouting or excessively loud verbalizations.	looking at reflection in materials not related to task, picking (nose, wall, table, carpet).

Inter rater Reliability

Inter rater reliability data were computed for observer data using Pearson Product Moment Correlation (Pearson's *r*). Pearson's *r* displays the correlation between two raters for continuous measurement scales with an absolute zero. The correlation results can range from negative one to positive one. A positive score indicates a direct relationship between raters (Salkind, 2013). In the current study two raters observed video taped data to document the occurrence of engagement measures. A "1" was documented if the behavior occurred and a "0" if it did not. Inter rater reliability was computed using Micosoft Excel® for each measure of engagement during all conditions for both participants (table 3). For participant J, observer data ranged from: r=.47 to.63. For participant A, observer data ranged from: r=.40 to .58. Exact *r* values are displayed in table 4. A moderate to strong positive relationship was observed between observers 1 and 2 when observing participant J. A moderate positive relationship occurred between observers 1 and 2 when observing Participant A.

Table 3.

Inter rater reliability data, Pearson's R values

	Traditional Materials	Music therapy	iPad	Music therapy and iPad
Participant J	0.53*	0.63**	0.49*	0.47*
Participant A	0.40*	0.41*	0.58*	0.51*

Note. *denotes a moderate positive correlation and ** denotes a strong positive correlation (Evans, 1996).

CHAPTER FOUR: RESULTS

Mean engagement scores for each participant were calculated per ten second interval. Each interval yielded a percentage score of engagement demonstrated by four observable behaviors (looking at appropriate materials, responding to the therapist, participation without challenging behaviors and on topic verbalizations). Means scores were calculated by taking the average between the two observers. The graphs (figures 1-8) show means engagement scores for each ten second interval treatment intervals within each five minute treatment interval over the two day period.

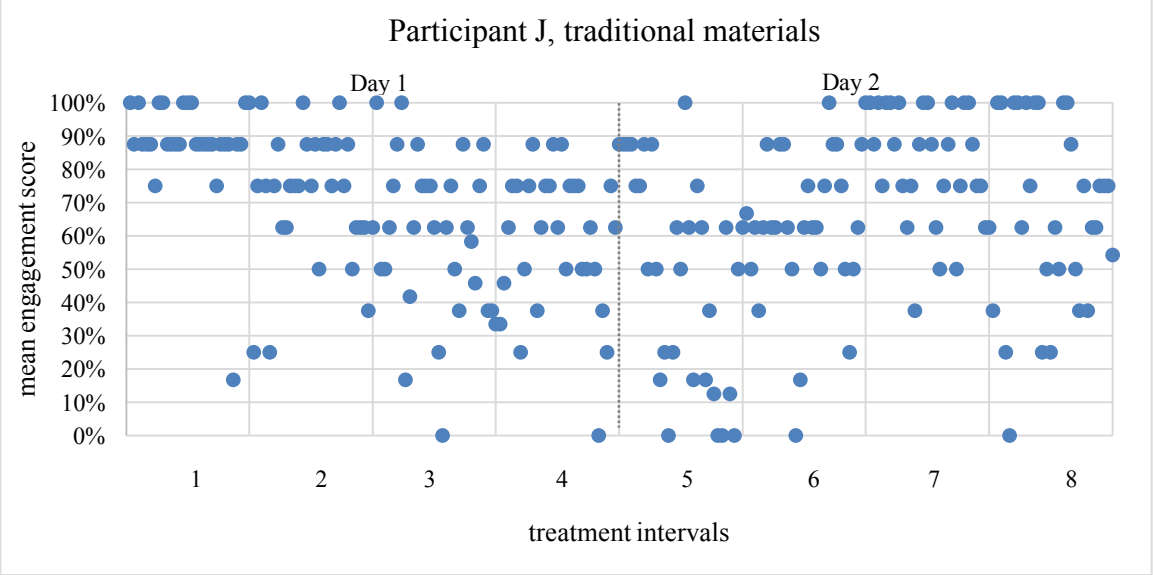
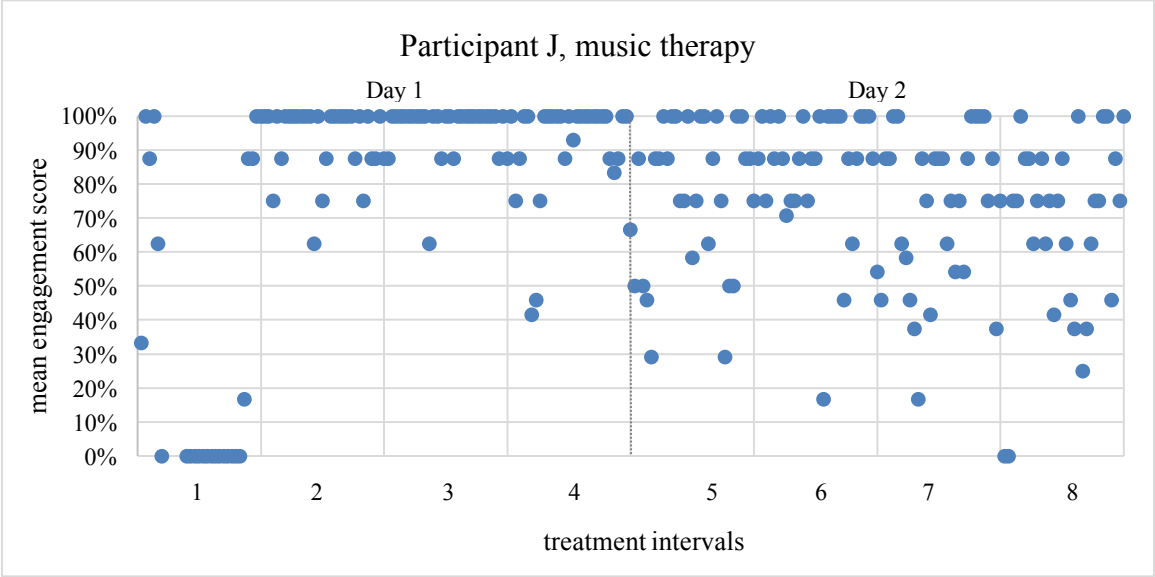
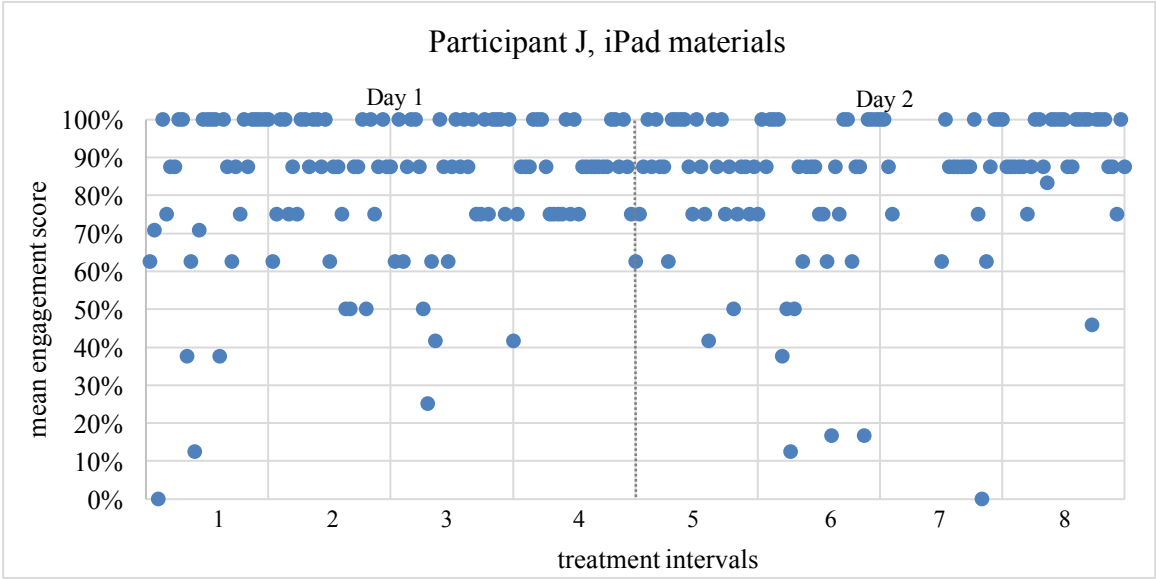
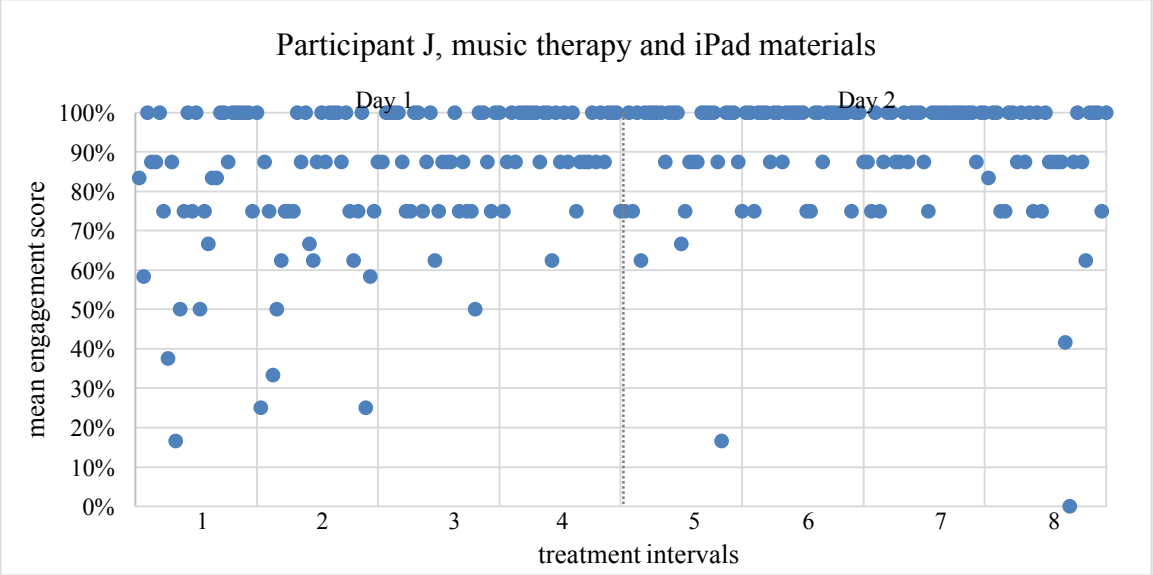


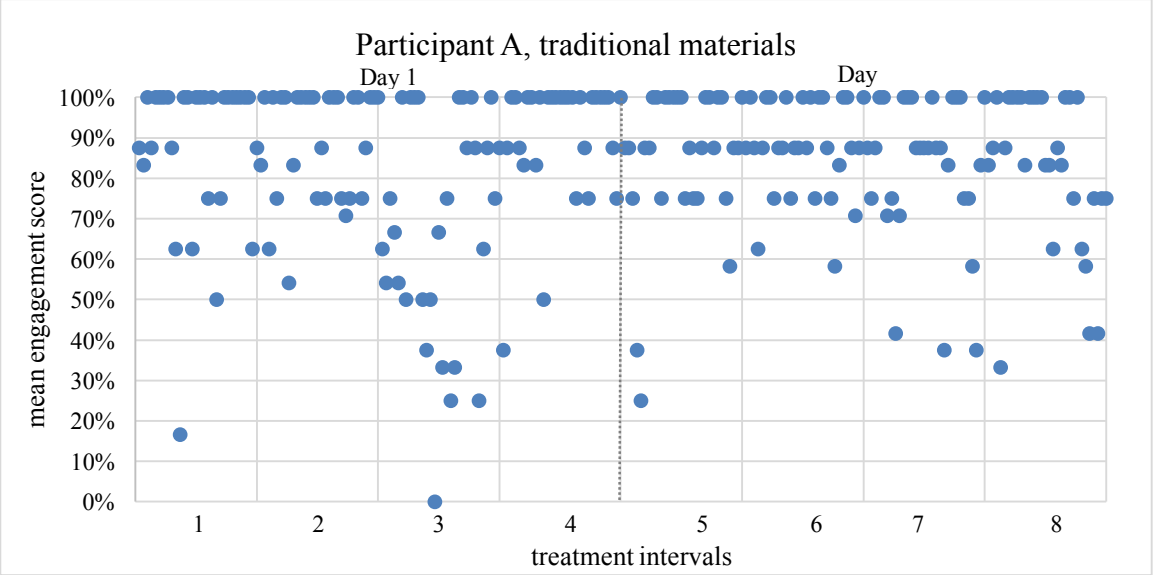
Figure 1. *Participant J's mean engagement scores for traditional materials per each ten second interval across all treatment intervals (each five minutes in duration). Each point on the graph represents a mean score for one ten second interval. Each treatment (including baseline) was conducted over two days (four per day). The grey lines separate the treatment intervals and the different days are seperated by a dotted line in the middle of the graph.*



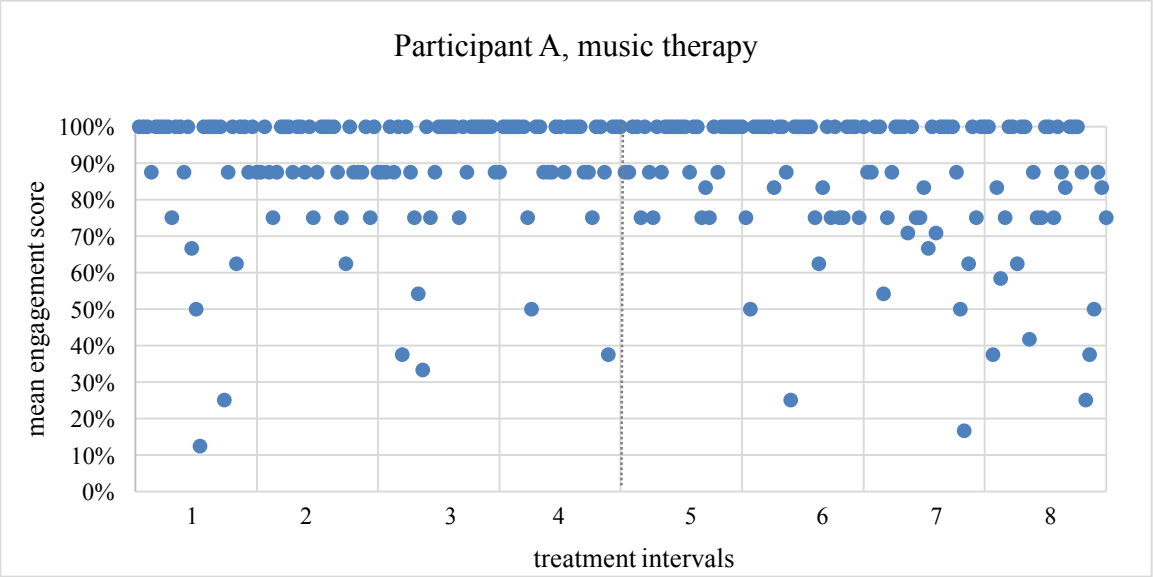


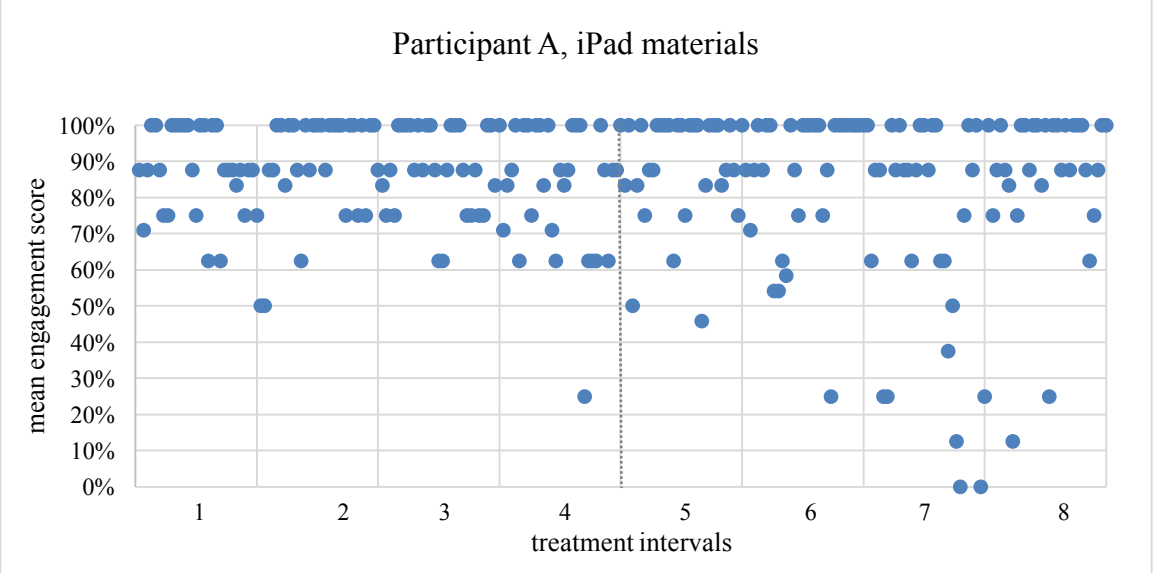
Figures 2 and 3. *Participant J's mean engagement scores for music therapy (above) and iPad® materials (below) per each ten second interval across all treatment intervals (each five minutes in duration). Each point on the graph represents a mean score for one ten second interval. Each treatment (including baseline) was conducted over two days (four per day). The grey lines separate the treatment intervals and the different days are seperated by a dotted line in the middle of the graph.*





Figures 4 and 5. *Participant J's mean engagement scores for music therapy and iPad® combined (above) and Participant A's (below) mean engagement scores for traditional materials (baseline) per each ten second interval across all treatment intervals (each five minutes in duration). Each point on the graph represents a mean score for one ten second interval. Each treatment (including baseline) was conducted over two days (four per day). The grey lines separate the treatment intervals and the different days are seperated by a dotted line in the middle of the graph.*





Figures 6 and 7. *Participant A's mean engagement scores for music therapy (above) and iPad® materials (below) for per each ten second interval across all treatment intervals (each five minutes in duration). Each point on the graph represents a mean score for one ten second interval. Each treatment (including baseline) was conducted over two days (four per day). The grey lines separate the treatment intervals and the different days are seperated by a dotted line in the middle of the graph.*

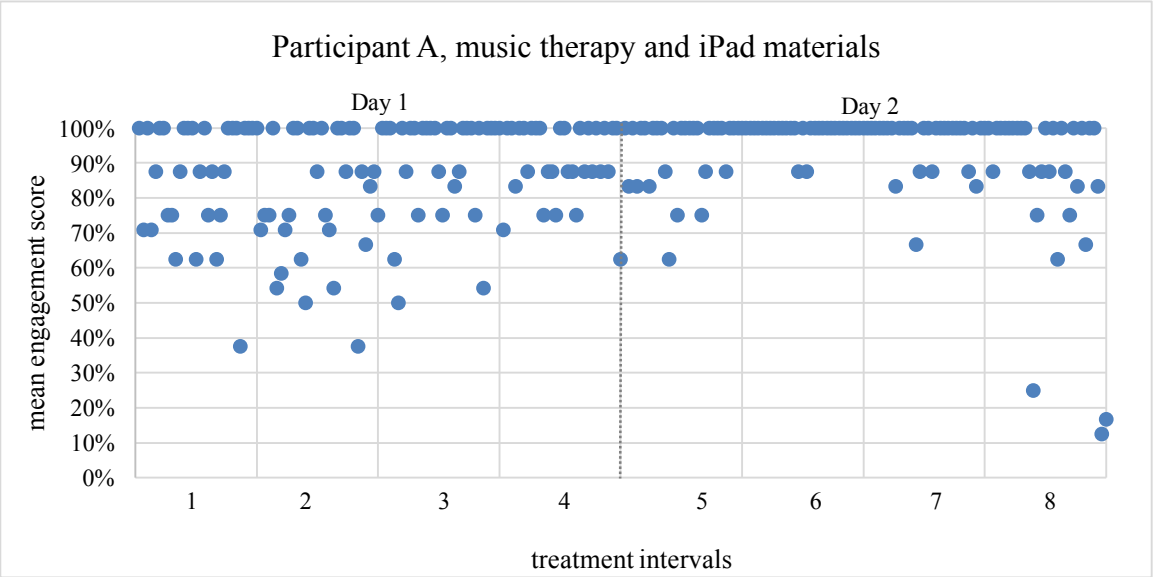


Figure 8. *Participant A's mean engagement scores for music therapy and iPad® materials for per each ten second interval across all treatment intervals. Each point on the graph represents a mean score for one ten second interval. Each treatment (including baseline) was conducted over two days in 5 minute treatment intervals. The different days are seperated by a dotted line in the middle of the graph.*

A mean score per session was then computed by averaging the scores between raters that occurred for each treatment interval (figures 9 and 10, table 4). Standard deviations were calculated per treatment for each participant (table 5). Participant J's average score for traditional materials equaled 67.36% (*SD = 26.04%*), 79.50% (*SD = 29.49%*) for music therapy, 83.40% (*SD = 19.95%*) for the use of iPad® materials, and 87.69% (*SD = 17.22%*) for music therapy combined with the iPad®. Participant A's average score for traditional materials equaled 84.38% (*SD = 19.72%*), 87.99% (*SD = 17.94%*) for music therapy, 85.23% (*SD = 19.94%*) for the use of iPad® materials, and 90.45% (*SD = 15.69%*) for music therapy combined with the iPad®. To visually inspect the possible impacts each condition had on each measure of engagement, each participants scores were computed to show mean scores for each treatment interval of engagement measures in isolation (figures 11 and 12, table 6).

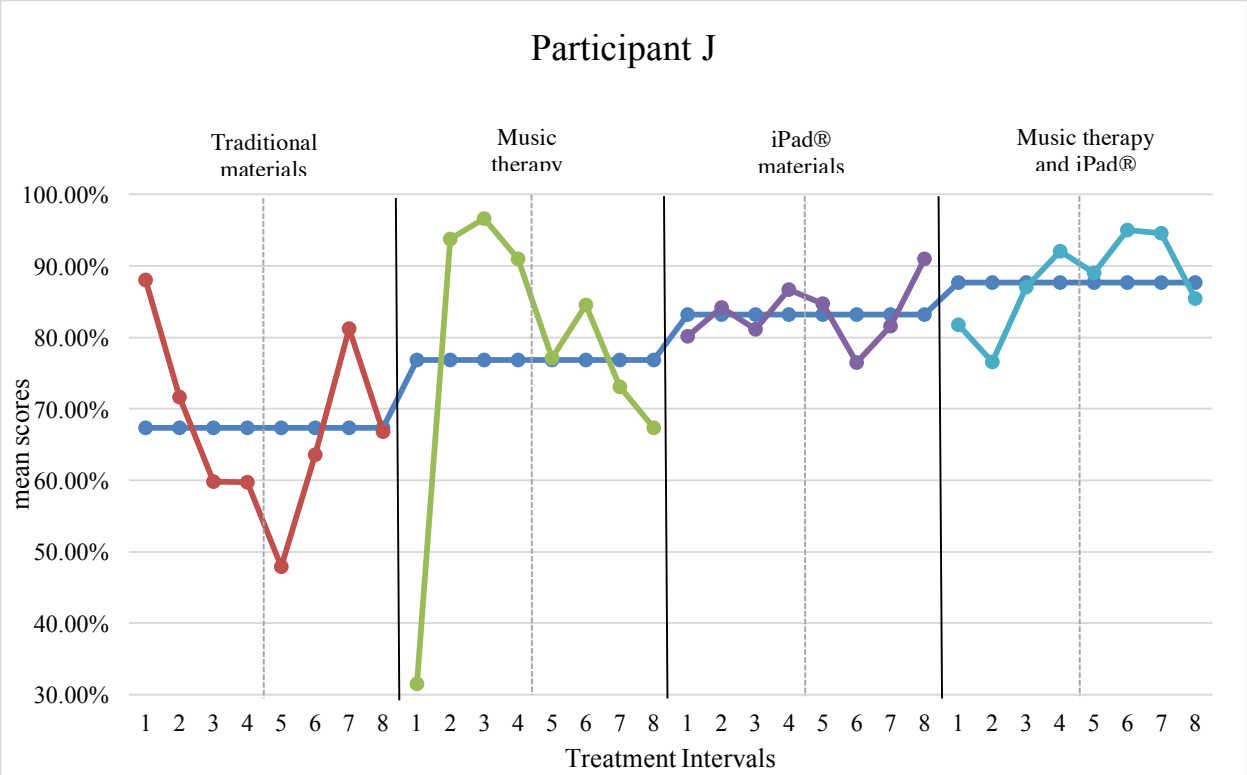


Figure 9. *Mean scores for the effects of the use of the iPad® in music therapy on Participant J. Solid lines separate the different treatments. Each treatment was tested for a total of eight treatment intervals over a two-day time period in a randomized and balanced order. The dotted lines separate scores that happened on different days. The dark blue line represents the mean score for each treatment.*

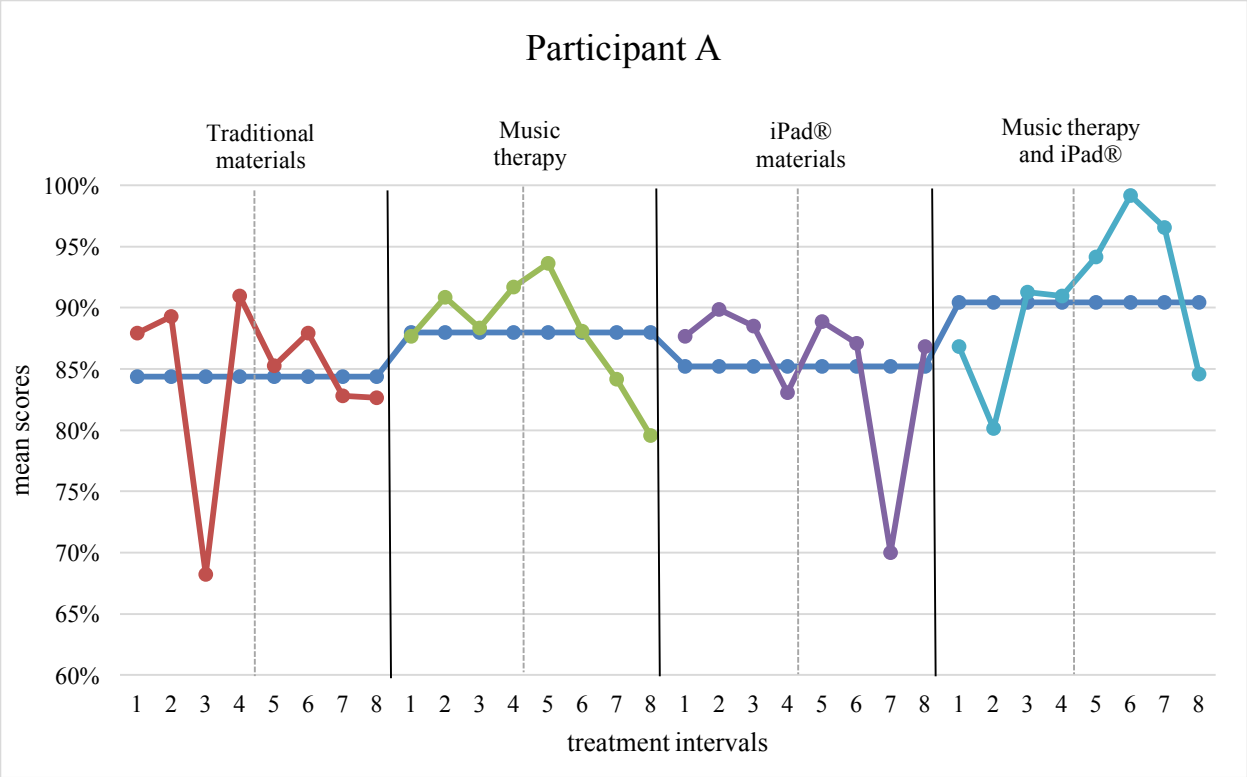


Figure 10. *Mean scores for the effects of the use of the iPad® in music therapy on Participant A. Solid lines separate the different treatments. Each treatment was tested for a total of eight treatment intervals over a two-day time period in a randomized and balanced order. The dotted lines separate scores that happened on different days. The dark blue line represents the mean score for each treatment.*

Table 4.

Mean scores per treatment interval for each participant.

Participant J								
	1	2	3	4	5	6	7	8
Traditional materials	88.06%	71.67%	59.86%	59.72%	47.92%	63.61%	81.25%	66.81%
Music therapy	31.50%	93.75%	96.67%	91.01%	77.08%	84.58%	76.53%	67.36%
iPad	80.14%	84.17%	81.11%	86.67%	84.72%	76.53%	81.58%	90.97%
Music therapy and iPad	81.81%	76.53%	87.08%	92.08%	89.03%	95.00%	94.58%	85.42%
Participant A								
	1	2	3	4	5	6	7	8
Traditional materials	87.92%	89.31%	68.91%	90.97%	85.28%	87.92%	82.78%	82.64%
Music therapy	87.64%	90.83%	88.33%	91.67%	93.61%	88.06%	84.17%	79.58%
iPad	87.64%	89.86%	88.47%	83.06%	88.89%	87.08%	70.00%	86.81%
Music therapy and iPad	86.81%	80.14%	91.25%	90.97%	94.17%	99.17%	96.53%	84.58%

Note. Treatment intervals 1-4 occurred on first assigned day of treatment and treatment intervals 5-8 occurred on the second assigned day of treatment.

Table 5.

Total mean scores and standard deviations for both participants of each treatment.		
Participant J		
	Means	Standard Deviations
Traditional materials	67.36%	26.04%
Music therapy	79.44%	29.49%
iPad	83.42%	19.95%
Music therapy and iPad	87.69%	17.22%
Participant A		
	Means	Standard Deviations
Traditional materials	84.38%	19.72%
Music therapy	87.99%	17.94%
iPad	85.23%	19.94%
Music therapy and iPad	90.45%	15.69%

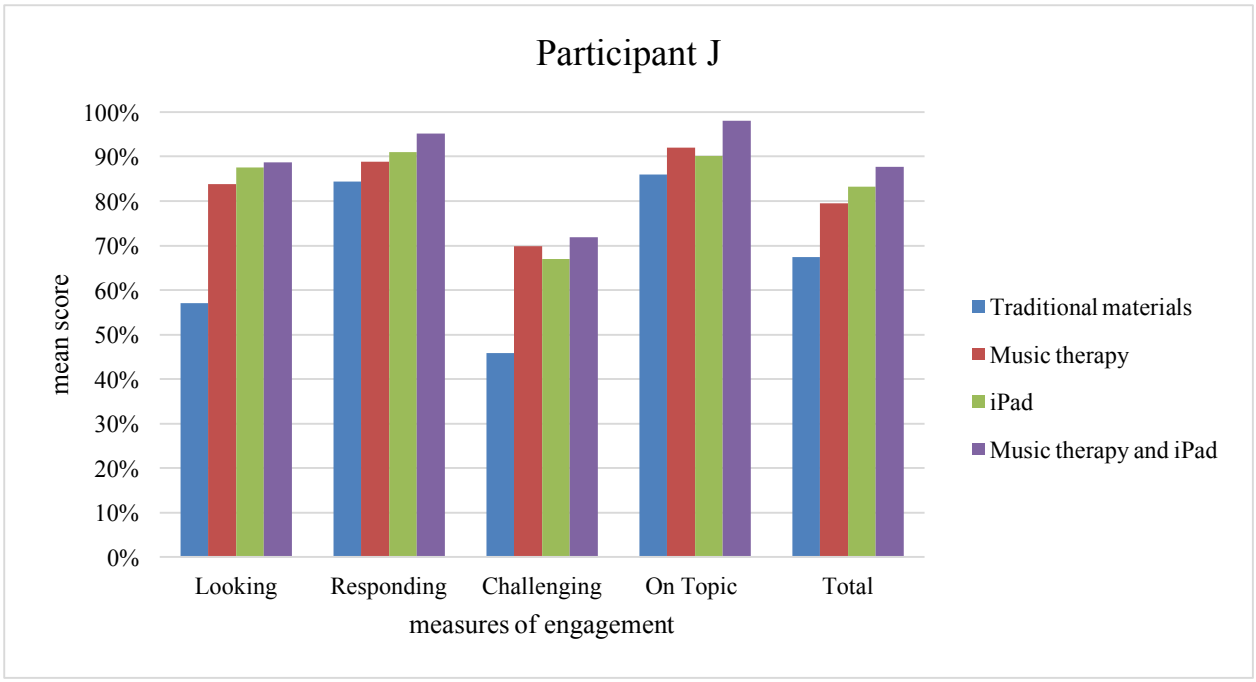


Figure 11. *Participant J's mean scores of each treatment interval per measure of engagement. The mean was computed by taking the average of all scores within each measure of engagement. The final group of bars displays the total (all measures combined) mean score for each treatment for comparison.*

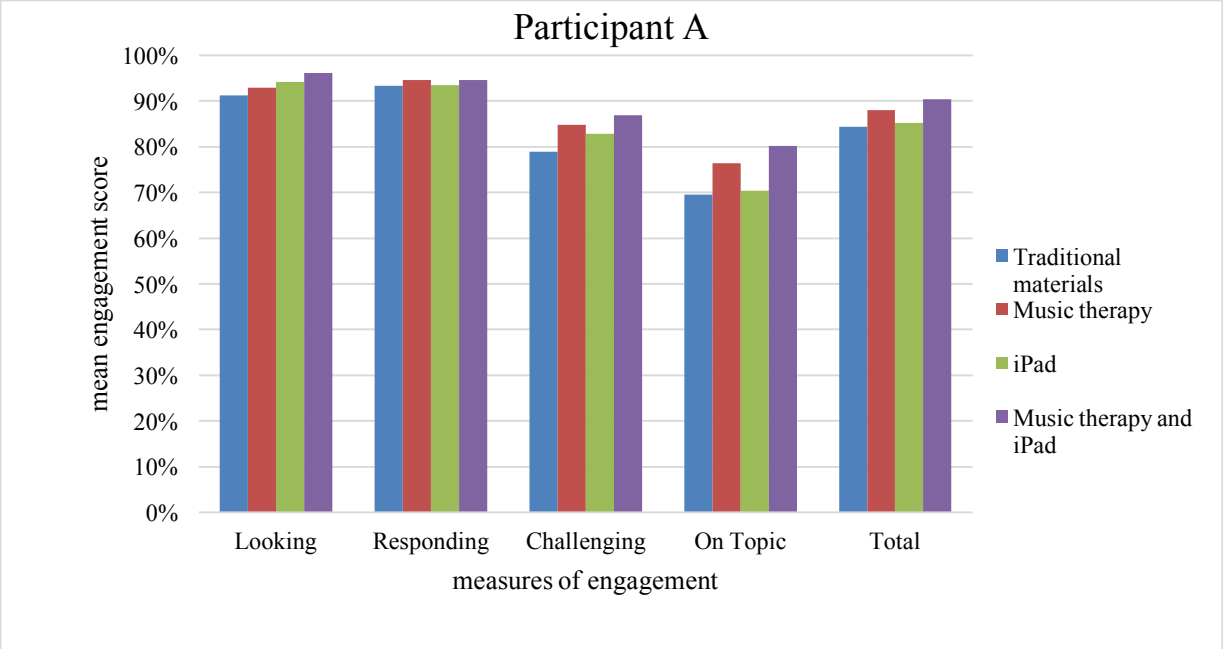


Figure 12. *Participant A's mean scores of each treatment interval per measure of engagement. The mean was computed by taking the average of all scores within each measure of engagement. The final group of bars displays the total (all measures combined) mean score for each treatment for comparison.*

Table 6.

Total mean scores and mean scores per measures of engagement in each condition.

Participant J					
	Looking	Responding	Challenging	On Topic	Total
Traditional materials	57.13%	84.36%	45.83%	86.04%	67.36%
Music therapy	83.85%	88.80%	69.90%	92.00%	79.44%
iPad	87.52%	90.95%	67.02%	90.08%	83.24%
Music therapy and iPad	88.66%	95.17%	71.88%	98.04%	87.69%
Participant A					
	Looking	Responding	Challenging	On Topic	Total
Traditional materials	91.20%	93.32%	78.96%	69.53%	84.38%
Music therapy	92.90%	94.63%	84.79%	76.37%	87.99%
iPad	94.15%	93.43%	82.86%	70.36%	85.23%
Music therapy and iPad	96.23%	94.61%	86.88%	80.23%	90.45%

CHAPTER FIVE: DISCUSSION

According to the Diagnostic and Statistical Manual 5 [DSM-5], individuals on the autism spectrum present with deficits in social communication and repetitive patterns of behavior, interests and activities (APA, 2013). These deficits occur across multiple settings and may contribute to challenges in academics, communication, attention and behavior (Armstrong et al., 2015; Autism Speaks, 2012; Brereton, Tonge, & Einfeld, 2006; Koegel et al., 2012; Mundy, 2007). The combined use of the iPad® and music therapy intervention was designed to provide a motivating and engaging intervention that can be adapted to individual students on the spectrum (Brownell, 2002; Kagohara et al., 2012; Kern, Wolery, & Aldridge, 2006; Neely et al., 2013).

Although clinical implications of the iPad® have not frequently been researched in the music therapy literature, there is ample literature supporting music therapy treatment for individuals on the autism spectrum and iPad® and technology use for individuals on the autism spectrum. More research is necessary to explore the combination in addition to extending existing support for both music therapy and technology in autism treatment.

The purpose of this study was to determine whether or not the iPad® could enhance music therapy sessions by reducing challenging behaviors and increasing engagement when addressing an academic task. This study aimed to expand on a previous study by Neely et al. (2013) that measured engagement in children on the autism spectrum by replacing traditional academic materials with iPad® materials. A single case, multiple treatment design was utilized to compare effects of the use of traditional materials, music therapy intervention, the use of

iPad® materials, and the combination of music therapy intervention and iPad® materials with two children on the autism spectrum working on individualized academic tasks.

The analysis of the data suggests that utilizing the iPad® and music therapy intervention in combination can increase engagement compared to using traditional materials. It is not as clear whether or not the iPad® enhances music therapy sessions. The results of this study were individualized per participant and showed less obvious trends when comparing music therapy intervention to music therapy interventions combined with the iPad®. This study expands on previous literature by adding to the existing knowledge that the use of iPad® can enhance engagement when addressing academic goals. It is inconclusive whether or not it adds to music therapy literature that technology enhances the music therapy process in children on the autism spectrum.

Total Mean Scores

Can the use of academic music therapy interventions have an effect on academic engagement? Based on visual inspection of the results of this study, music therapy can increase engagement while working toward academic tasks. Participant J saw a larger increase between traditional materials and music therapy intervention, and increase of 12.08%. Participant A saw a more modest increase between traditional materials and music therapy intervention, 3.61%. The frequency tables display the break down each ten second interval score. Comparing frequency tables for Participant J, there is a higher concentration of scores above 75% during music therapy, especially day 1. The frequency tables for Participant A do not show as much of a difference in distribution of scores between traditional materials and music therapy, as reflected in the slight increase of total score. This is consistent with mean total scores displayed on the line graph. However, as seen on the line graph both participant's J and A scored higher

maximum scores during music therapy intervention than traditional materials. Participant J's lowest score for the project occurred during music therapy, this occurred when he left the treatment room for a sustained amount of time. Participant A also scored the highest score between the two treatments during music therapy but her lowest score occurred while using traditional materials.

These findings are consistent with the existing literature. Ample research denotes that music increases positive affect (Blood and Zatorre, 2001; Menon and Levitin, 2005; Salimpoor et al., 2011), activates dopaminergic regions of the brain (Stegemöller, 2014) and thus creates an enhanced learning environment (Montague et al., 1996; Wise, 2004). The music therapy intervention utilized in this study was tailored to each participant and task. Although both participants were addressing a non preferred task both were willing to participate in music therapy intervention addressing the task.

Can iPad® use have an effect on academic engagement? Comparing the use of the iPad® to traditional materials, participant J showed a larger increase of 15.88% when utilizing the iPad®. This was a 3.80% difference increase from music therapy intervention alone. Participant A increased by .85% between utilizing iPad® and traditional materials. She scored a higher mean score utilizing music therapy intervention alone compared to iPad® materials, a difference of 2.76%. Frequency tables of all ten second intervals for Participant J show more consistent scores from day 1 to day 2 when utilizing the iPad®. There also appear to be fewer scores below 50%. Though the total means are not drastically increased for Participant A, the frequency tables illustrate more focused and consistent scores for Participant A when utilizing the iPad®, especially on day 1. The line graphs displaying total mean scores show an increase trend for participant J. A trend is less discernable for Participant A. Her lowest score between

music therapy and iPad materials occurred during the iPad® condition. This is consistent with the existing literature. iPad® materials have been suggested favorable to traditional materials in numerous studies with individuals on the autism spectrum (Achmadi et al., 2012; Kagohara, et al., 2012; van der Meer, Didden, et al., 2012; van der Meer, Sutherland, O'Reilly, Lancioni, & Sigafoos, 2012).

Can the integration of academic music therapy interventions and iPad® use have an effect on academic engagement? It appears both participant's results were higher utilizing a combination of music therapy intervention and iPad® materials. Participant J scored a large difference from the combination condition to traditional materials, an increase of 20.33%. This was an 8.25% increase from music therapy alone, and a 4.46% increase from utilizing only the iPad®. Participant A scored her largest increase, 6.08% higher when utilizing the combination of music therapy intervention and iPad® materials compared to traditional materials. This was a 2.47% increase from music therapy intervention in isolation and a 5.23% increase from the iPad® in isolation. Inspecting the frequency tables for Participant J one would see consistency trends but even more so on the second day of music therapy intervention integrated with iPad® materials. On day two of the combined condition, there were only three scores below 50%. This is consistent for Participant A. One can also see a consistency trend throughout the entire condition but the second day a stronger trend appears with only three scores below 60%.

When comparing the resulted means, overall the iPad® and music therapy intervention condition yield the highest scores. This is congruent with the expectations based on the literature review and of this researcher. As noted in research, systematic application of elements of music, rhythm, harmony, form and melody, can prepare and motivate a person for learning (Hardy and LaGasse, 2013; Merrett et al., 2014; Stegemöller, 2014). The iPad® provides a custom, familiar,

concrete and visually preferred stimulus (Kagohara et al., 2012; Mineo et al., 2009; Neely et al., 2013). Though some are slight, the findings show consistent increases that may be indicative of the rationale for combining the use of music therapy and the use of the iPad®.

Specific Engagement Measures

The study in replication (Neely et al., 2013) specifically examined occurrences of challenging behaviors when participant's utilized the iPad®. The current study analyzed challenging behaviors among other measures of engagement. The bar graphs display each measure of engagement (looking at appropriate materials, responding to the therapist, participation without challenging behaviors and on topic verbalizations). For participant J, the largest increases across all measures of engagement occur when comparing traditional materials scores to music therapy combined with iPad® scores. The largest increase occurred in the scores examining looking at relevant materials (a 31.53% increase), followed by participation without challenging behaviors (a 26.04% increase), with on topic verbalizations being the next largest increase (12.01%) and then an increase of 10.81% for responding to the therapist. Participant A also scored consistent increased results across meaures of engagement while utilizing the iPad® combined with music therapy intervention. The largest increase occurred for on topic verbalizations (a 10.70% increase), followed by participation without challenging behaviors (7.92% increase), then looking at relevant materials (5.03% increase) and finally a small increas of 1.29% was observed for responding to the therapist.

Perhaps some of the most notable increases observed were in specific measures of engagement. Differences in visual engagement may contribute to a person on the spectrum's difficulty engaging socially or in activities that require joint attention (Hernandez et al., 2009; Pelphrey et al., 2012; Mundy, 2007). In this study, the introduction of the iPad® had a large

impact on Participant's J's ability to visually attend to the assigned materials. Though more modest differences were observed for Participant A, her largest increase in specific engagement measures was in on topic verbalizations. The content of Participant A's off topic verbalizations included irrelevant songs, protests or requesting other materials. In an article by Sanders et al., (2008) findings suggest individuals with autism have difficulty orienting to task. Utilizing the iPad® combined with music therapy intervention seemed to create the best possible environment within the treatment conditions for her to disengage from irrelevant topics and engage with the task.

Limitations

There were several limitations to the current study. In the interest of maximizing potential for generalization, single case research design was utilized. This design and utilizing continuous assessment allowed for greater internal validity and ecological validity. However, this compromised the ability to use a larger sample size. Chosen participants were able to represent a similar age range and include a male and female participant. However, due to the constraints of the convenience sample both participants were of similar skill level. Both verbally communicate, are close to age appropriate reading and writing levels and attend general education classrooms with supports. Further studies might expand the population to include a wider range of ages and skill levels and may test with more participants in order to show a stronger effect. Additionally, future studies may also consider testing over a longer period of time and include variable interval assessment procedures.

While increases were observed for both participants across conditions, inter rater reliability was primarily at moderate positive levels, one area displayed a strong positive correlation (Evans, 1996). While the relationship was positive and directly correlated, a stronger

correlation would indicate more agreement between observers. To strengthen the results, further studies should consider training observers to code data, checking reliability until a given standard of accuracy is achieved. After this training the observers would then be asked to complete rating the remaining data.

Both participants showed a level of protesting and stress regarding the task. Within the treatment context, the tangible items used during the traditional materials may have created negative associations for those items since traditional materials were presented first. This may have impacted the music therapy condition since it utilized these items. Further studies should also randomize and balance all conditions.

The nature of individualizing the academic task to each participant presents limitations to the findings of this study. Participant J's task (multiplication tables) was extremely concrete and included one step. Each time was prompted with a problem he simply was expected to verbalize the answer. Participant A's task was more complex. Elapsed time required her to assess two times of day, complete an algorithm, make decisions regarding addition or subtraction and write the correct answer. The complexity level of A's task may have impacted the effects from treatment conditions. Further studies should examine individualized tasks of a similar difficulty level.

Additionally, only one level of music was tested. The music utilized in this study was highly structured to facilitate the completion of the academic tasks. Perhaps future studies might examine the motivation of music alone (for example, preferred background music) to determine whether or not music alone might have an impact on engagement. Lastly, one other notable limitation is that the conditions compared the use of materials to the systematic application of an intervention. The researcher provided a music therapy intervention utilizing current research and

individualized knowledge gained from rapport with both participants. The researcher was not able to provide this level of expertise when presenting traditional materials and the iPad® without music therapy.

Clinical Implications and Conclusion

This exploratory investigation demonstrated the advantages and disadvantages of since case multiple treatment design. Visual presentation of results among treatments clearly displayed increases in specific measures of engagement for comparison of treatments. The above mentioned limitations illustrate compromises inherent in the design and considerations for future study. These considerations limit the ability to determine whether or not the study was conclusive. However, the information and findings from this thesis can be used to further the treatment of Participant A and Participant J. As the iPad® may contribute to increases looking at assigned materials for Participant J and on topic verbalizations for Participant A, both possible difficulties for individuals on the autism spectrum (Hernandez et al., 2009; Mundy, 2007; Pelphrey et al., 2012; Sanders et al. 2008).

In addition, this information can inform future studies. There are no other known studies that examine the use of the iPad® in music therapy sessions targeting academic engagement with individuals on the autism spectrum. More research is necessary to refine what tasks are appropriate for the use of iPad® materials to be integrated within music therapy sessions.

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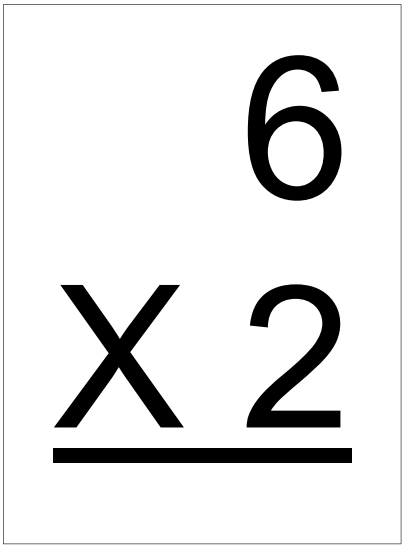
APPENDIX A

Traditional materials used



Flashcard example used with participant J.

Name: _____ Score: _____

Elapsed Time

Find the elapsed time for each problem.

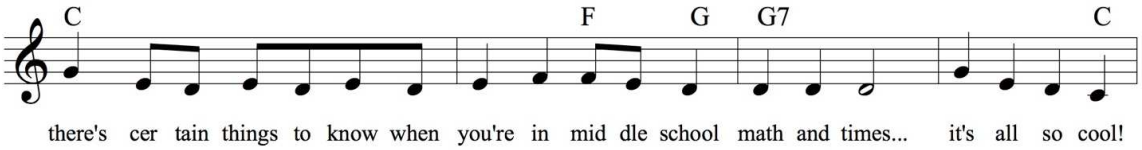
Q.No	Start Time	End Time	Elapsed Time
1)	8:25 A.M.	9:47 A.M.	
2)	1:28 P.M.	8:50 P.M.	
3)	3:14 A.M.	6:35 A.M.	
4)	5:35 P.M.	11:40 P.M.	
5)	2:49 A.M.	7:38 A.M.	
6)	10:30 P.M.	11:59 P.M.	
7)	6:17 A.M.	6:57 A.M.	
8)	4:12 P.M.	10:00 P.M.	
9)	7:36 A.M.	9:42 A.M.	
10)	3:40 P.M.	7:30 P.M.	
11)	7:20 P.M.	8:35 P.M.	
12)	6:19 A.M.	11:27 A.M.	
13)	1:32 A.M.	5:47 A.M.	
14)	2:34 P.M.	10:19 P.M.	
15)	5:10 A.M.	8:23 A.M.	

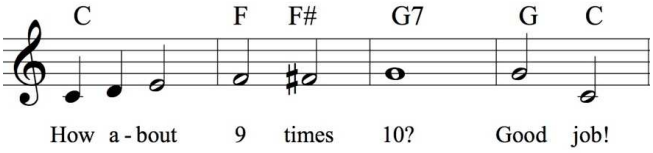
Printable Math Worksheets @ www.mathworksheets4kids.com

Worksheet example used with participant A.

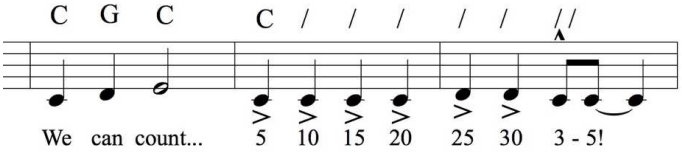
APPENDIX B

Music materials used

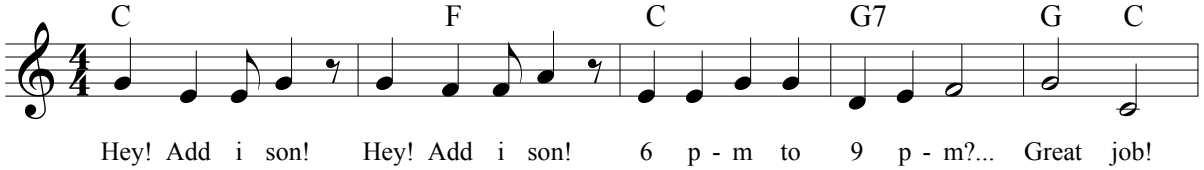




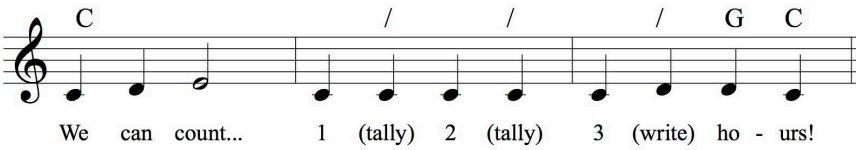
Musical cue for participant J.



Musical cue for problem solving with participant J.



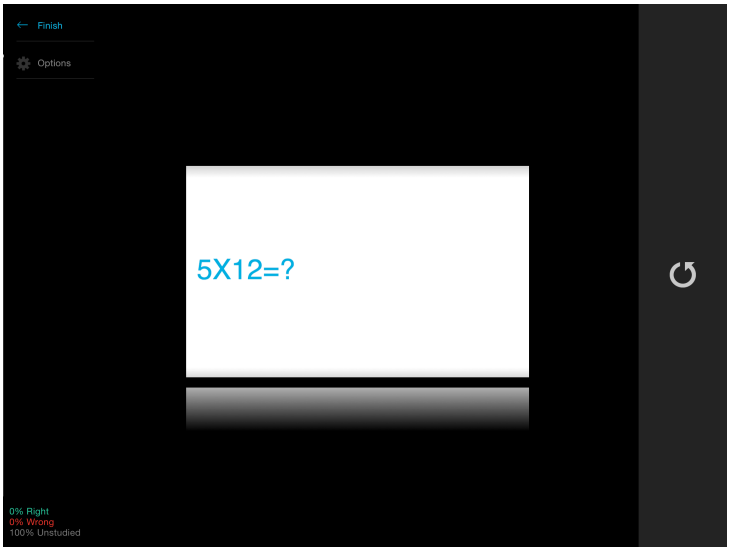
Musical cue for participant A (different name used in lyrics).



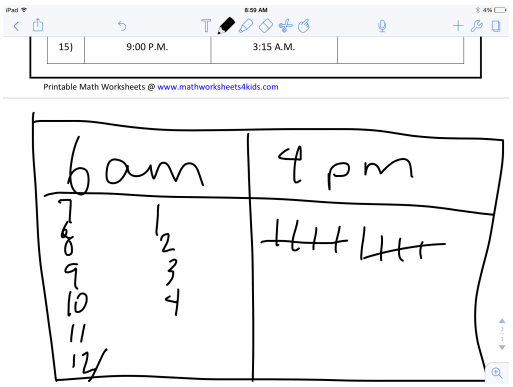
Musical cue for problem solving with Participant A.

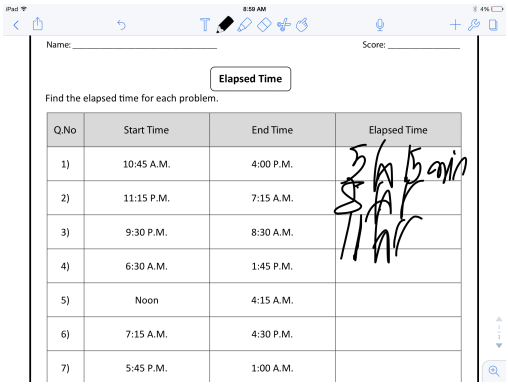
APPENDIX C

iPad® materials used.



iPad® materials used for Participant J





iPad® materials used for Participant A

APPENDIX D

Consent to Participate in a Research Study
Colorado State University

TITLE OF STUDY: Effects of iPad® Use and Music Therapy in Autism

PRINCIPAL INVESTIGATOR: Blythe LaGasse, Ph.D., MT-BC, Coordinator of Music Therapy, blythe.lagasse@colostate.edu, (970) 491 4042

CO-PRINCIPAL INVESTIGATOR: Mary Scully, MT-BC, music therapy graduate student, marykscully@gmail.com, (616) 403 9380

WHY AM I BEING INVITED TO TAKE PART IN THIS RESEARCH? Your son or daughter is being asked to participate in this research because he or she already participates in music therapy sessions to enhance his or her engagement. In addition, identified participants carry an autism diagnosis and are of school age.

WHO IS DOING THE STUDY? The research team is made up of Dr. Blythe LaGasse, supervisor, Mary Scully, music therapist, and two additional Opportunities for Positive Growth music therapists.

WHAT IS THE PURPOSE OF THIS STUDY? The purpose of the study is to determine if using an iPad® during music therapy can increase engagement.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST? The study will take place at your regular music therapy location: Opportunities for Positive Growth. The total length of the project is 4 weeks. You will be asked to continue to attend music therapy (twice weekly) during your usual session times.

WHAT WILL I BE ASKED TO DO? During regular music therapy sessions, your child will participate in music therapy interventions similar to what he or she already has experience with to compare music therapy with and without the use of the iPad®. To make this comparison your child work on an academic skill by using:

- Typical music therapy interventions
- The iPad only
- Typical music therapy interventions integrated with the iPad®

ARE THERE REASONS WHY I SHOULD NOT TAKE PART IN THIS STUDY? Your child should not participate if he or she has any other disability.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

- There are no known risk or discomforts to participate in this study.
- It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

ARE THERE ANY BENEFITS FROM TAKING PART IN THIS STUDY? There are few studies examining music therapy and iPad® use. The music therapy literature may benefit from this study as it could add to the existing literature on this topic. Your child may benefit directly by determining if iPad® use will enhance his or her music therapy treatment to aid in achieving his or her personal goals.

DO I HAVE TO TAKE PART IN THE STUDY? Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

WHO WILL SEE THE INFORMATION THAT I GIVE? We will keep private all research records that identify you, to the extent allowed by law. Only the research team will have access to the link between your child and your child's data. The only exceptions to this are if we are asked to share the research files for audit purposes with the CSU Institutional Review Board ethics committee, if necessary. You should know, however, that there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court OR to tell authorities of any suspected abuse, or you pose a danger to yourself or someone else.

CAN MY TAKING PART IN THE STUDY END EARLY? You may choose to not participate in this study at any point.

WHAT HAPPENS IF I AM INJURED BECAUSE OF THE RESEARCH? The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

WHAT IF I HAVE QUESTIONS? Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions about the study, you can contact the investigator, Mary Scully at 616-403-9380. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655. We will give you a copy of this consent form to take with you. This consent form was approved by the CSU Institutional Review Board for the protection of human subjects in research on (Approval Date).

WHAT ELSE DO I NEED TO KNOW? Your child's sessions will be video taped for data review. These video recordings will be kept on a password protected computer in a locked building when not in use.

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing pages.

PARENTAL SIGNATURE FOR MINOR

As parent or guardian I authorize _____ (print name) to become a participant for the described research. The nature and general purpose of the project have been satisfactorily explained to me by _____ and I am satisfied that proper precautions will be observed.

_____

Minor's date of birth

_____

Parent/Guardian name (printed)

_____ _____

Parent/Guardian signature Date

APPENDIX E

Assent to Participate in a Research Study
Colorado State University

PROJECT TITLE: Effects of iPad® Use and Music Therapy in Autism

PRINCIPAL INVESTIGATOR: Blythe LaGasse, Ph.D., MT-BC, Coordinator of Music Therapy, blythe.lagasse@colostate.edu, 970-491-4042

CO-PRINCIPAL INVESTIGATOR: Mary Scully, MT-BC, music therapy graduate student, marykscully@gmail.com, 616-403-9380

We are doing a research study about using the iPad® during music therapy. A research study is a way to learn more about people. If you decide that you want to be part of this study, you will be asked to use the iPad®, sing or play instruments, and sing or play instruments with the iPad®.

There are some things about this study you should know. These are the procedures: one day we will work on a school skill, another day work the same school skill with music, another day work on the same school skill with the iPad® and finally work on the same skill with music and the iPad®. We'll work on it for about 30 minutes during music therapy for one month. You'll come to sessions twice a week so the total commitment is about 8 hours. Sometimes it might be challenging but that's okay, please try your best! The research team will measure engagement. Engagement means how interested you are. The sessions will be videotaped so we can accurately measure.

Not everyone who takes part in this study will benefit. A benefit means that something good happens to you. We think the benefits might be achieving your goals during music therapy.

When we are finished with this study we will write a report about what was learned. This report will not include your name or that you were in the study. You do not have to be in this study if you do not want to be. If you decide to stop after we begin, that's okay too. Your parents know about the study too.

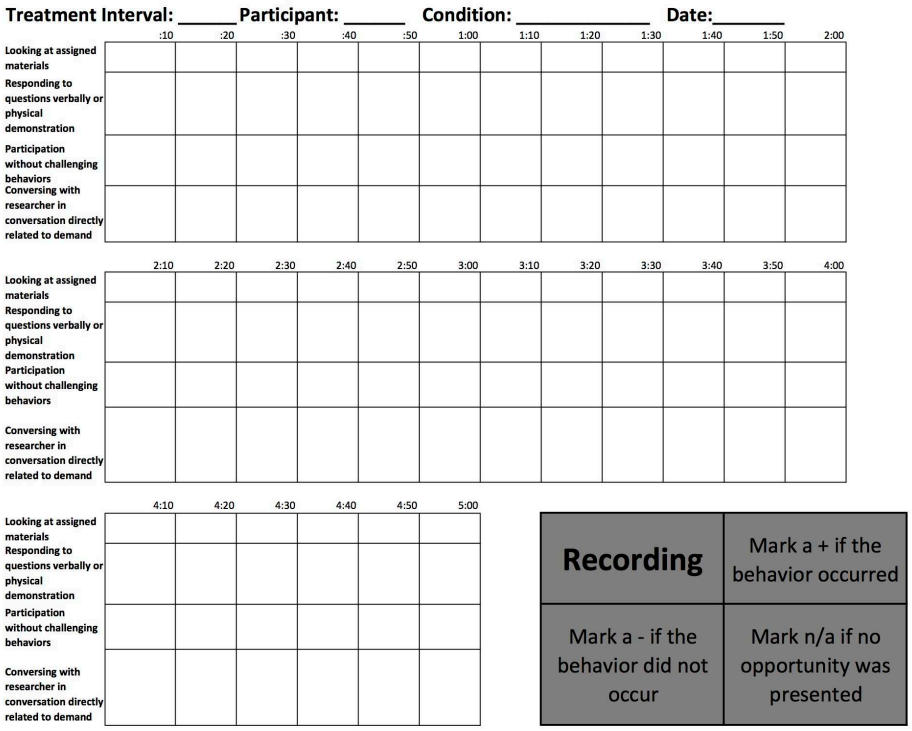
If you decide you want to be in this study, please sign your name.

I, _____, want to be in this research study.

_____ _____
(Sign your name here) (Date)

APPENDIX F

Data collection sheet provided to observers.



Treatment Interval: _____ Participant: _____ Condition: _____ Date:_____

	:10	:20	:30	:40	:50	1:00	1:10	1:20	1:30	1:40	1:50	2:00
Looking at assigned materials												
Responding to questions verbally or physical demonstration												
Participation without challenging behaviors												
Conversing with researcher in conversation directly related to demand												

	2:10	2:20	2:30	2:40	2:50	3:00	3:10	3:20	3:30	3:40	3:50	4:00
Looking at assigned materials												
Responding to questions verbally or physical demonstration												
Participation without challenging behaviors												
Conversing with researcher in conversation directly related to demand												

	4:10	4:20	4:30	4:40	4:50	5:00
Looking at assigned materials						
Responding to questions verbally or physical demonstration						
Participation without challenging behaviors						
Conversing with researcher in conversation directly related to demand						

Recording	Mark a + if the behavior occurred
Mark a - if the behavior did not occur	Mark n/a if no opportunity was presented