AN ANALYSIS OF THE AFFECT THAT MUSIC HAS ON THE LEVEL OF ENGAGEMENT AND THE RATE OF EFFICIENCY DURING A STRUCTURED TASK FOR STUDENTS WITH AUTISM SPECTURM DISORDER

By

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A Thesis Presented to

The Faculty of Humboldt State University

In Partial Fulfillment of the Requirements for the Degree

Master of Arts in Education

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December 2018

ABSTRACT

AN ANALYSIS OF THE AFFECT THAT MUSIC HAS ON THE LEVEL OF ENGAGEMENT AND THE RATE OF EFFICIENCY DURING A STRUCTURED TASK FOR STUDENTS WITH AUTISM SPECTRUM DISORDER

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Students with Autism have a difficult time engaging in structured activities. This study will look at the effectiveness of using music as an intervention during structured activities to increase the level of engagement in students with autism by measuring time on task during a math skills activity. This is a single case research study of an 18-year-old male student with ASD. The student will be measured using alternate treatment variables in which the student will be instructed to wear headphones with classical music for a measured amount of time, and then alternatively, for the same amount of time, without headphones. The outcome will be measured by rate efficiency while completing a structured task and be determined by the elapsed time to complete the task from start to finish. This study will take place during the student's typical math practice time once every school day for three weeks.

ACKNOWLEDGEMENTS

This research would not have been possible if not for the support from some key people in my life. I would like to recognize the faculty and staff at Humboldt State University who helped not only with the academic process, but also to ease the stress associated with taking on a thesis for the Masters of Education Program. I would specifically like to recognize and thank David Ellerd, Betty Durso, and Eric Van Duzer, each of whom took extra time out of their required duties as faculty to talk on the phone, meet in person, and give the valuable criticism that is required throughout the research and writing process. The process was not easy, but the faculty at Humboldt State provided me with the necessary tools to see and march toward the light at the end of the tunnel.

I would also like to acknowledge my wife Sarah Vitello-Bradshaw for listening to my endless chatter about this project and who provided me with the emotional support to keep going. You encouraged me to take the project on piece-by-piece, which allowed me to have minimal opportunities to feel overwhelmed. You helped me keep some sort of balance in my life throughout all aspects during the research and the writing process. It was comforting to know even without a thesis I would still have you.

I would like to acknowledge my parents Kent and Teri Bradshaw for always encouraging me to follow my passions and pursue higher education. This would not have been possible if not for you pushing me to go outside of what I was comfortable. Your encouragement and belief in my abilities has been beneficial in all parts of my life.

Lastly, I would like to recognize my dog Penny Layne Bradshaw, for being a great distraction. You always knew when to come in and lay on the keyboard or just do something generally cute. Without all of you, none of this could have happened, and I thank you.

DEDICATION

I dedicate this research study to the students on the Autism Spectrum, along with the all of teachers and staff that work to help them meet their academic and social goals. Students with Autism often have unique needs that they can't communicate in the traditional way. I have seen so many of my fellow teachers and colleagues persevere through these communication deficits using an array of techniques, so that these students are able to thrive and be capable of some form of autonomy. Witnessing these teachers in action using methods that I personally wouldn't have thought of using, but provide results is what inspired my research. I implore teachers to keep thinking outside of the box for our unique learners and I believe positive change will follow.

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CHAPTER ONE: INTRODUCTION

A key part of any student's success at school relies on their ability to complete tasks assigned by the teacher, and do so in a time efficient manner. This is true of those with or without disabilities, those who speak fluent English or are English Language learners, and those from ages ranging in pre-k to adult learners. This being said, the act of completing a task assigned by a teacher becomes increasingly difficult the farther a student falls from the mark of "typically developing." For students to be successful academically, socially and in the future workplace, they must display the ability to maintain attention to tasks, communicate effectively, engage socially and participate in activities with their peers (Newschaffer, Falb, & Gurney, 2005). People with Autism often need many supports in order to complete tasks at school that might be easy for others. Common attributes to Autism Spectrum Disorder (ASD) involve rigidity about time, eating, dressing, and schedule or routine. Because of this, people with Autism may also display disruptive behaviors when their routines are changed, they are denied a preferred item, or they are presented with a difficult, or non-preferred task (Reese, Richman, Belmont, & Morse, 2005).

The purpose of this study was to study the affect that music has on the level of engagement and the rate of efficiency during a structured task for students with autism spectrum disorder. The literature review analyzes previous research describing historical and current trends in the use of music to increase engagement for students with autism. The literature review will discuss the current prevalence of Autism Spectrum Disorder

(ASD), common characteristics of people with autism, current research-based interventions for students with autism, difficulties of engagement, attention, and participation for students with autism, and the benefits of using music as a means of increasing engagement for students with autism. Chapter 2 will also discuss people with Autism's need for educational services and current U.S. policy and federal law outlining the rights of students with disabilities. It goes on to discuss music and Autism, as well as the universality and importance of music to people across cultural, racial, and disability spectrums.

Chapter 3 includes a detailed description of the methodology used to implement the study. It also includes a description of the participant in the study, the setting, materials used and the second observer in the study. Independent variables and treatment conditions are explained as well as experimental design and procedure. Chapter 3 also includes a rational for the design of the study and a discussion of the social validity of the participant to the study.

This study concludes with Chapter 4, which includes graphs, tables, and discussion of findings. Graphs and tables show the difference in both treatments used as well as the average rate of efficiency with and without the treatment over 14 trials. The analysis in this section also includes the limitations of the study and implications for future research and teacher practice.

Research Question and Rationale

The current study was a single case research study using an alternating treatment design that compared the amount of time it took a student with autism to complete a structured task under two different conditions with one condition being completing the task while listening to music with headphones and the other being completing the task without the use of headphones and music. The goal of this research design was to determine whether the student's engagement and time on task was increased with the presence of music.

CHAPTER TWO: LITERATURE REVIEW

Prevalence

The number of individuals diagnosed with Autism Spectrum Disorder (ASD) has been rising over the years with autism having a reported prevalence rate of four affected individuals out of 10,000 in 1966 (Lotter, 1966). As of 2014, the Centers of Disease Control and Prevention reported that one in 68 babies born are diagnosed with ASD, with boys affected at a rate of almost five times more than girls. Autism has an impact on people from every race, ethnic and social economic group (Christensen et al., 2016). Current research indicates that definitive causes for autism are still unknown, but there are many environmental and genetic risk factors associated with the disease (Landrigan, 2010). Autism is a spectrum disorder, meaning that it affects individuals to varying degrees. There are three different defined levels where an individual might fall on the spectrum. Different levels require different responses. According to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders an individual at level one requires general support in their daily routine, whereas an individual at level three requires substantial support (American Psychiatric Association, 2013).

Characteristics of Autism Spectrum Disorder

People with autism can experience deficits in several areas affecting their daily lives. These deficits may be characterized as problems with effective communication, the ability to socialize with others, academic achievement and the ability to obtain and

maintain meaningful employment (American Psychiatric Association, 2013). Autism is often paired with social (pragmatic) communication disorder, which is a deficit in using verbal and non-verbal communication in social situations (American Psychiatric Association, 2013). People with autism can be challenged with understanding and adhering to general rules of conversation. These communication deficits may hinder them from socially engaging with others. Individuals with autism can struggle with normal day-to-day social situations such as simply greeting a familiar person or sharing what they did over the weekend. They have difficulty taking turns in conversation and understanding non-literal language, such as the use of humor and metaphors. People with autism can be averse to initiating social interactions and will take fewer turns when engaging conversationally (Jones & Schwartz, 2009). Attempts at conversation or making friends can come off as odd and fail to get the desired result. Play skills that come naturally to a typically developing child must be taught to someone with autism in order for them to successfully develop relationships with others (Rao, Beidel, & Murray, 2008). Someone at level one on the spectrum may experience these deficits more mildly whereas a person at level three may not even have the ability to speak (American Psychiatric Association, 2013).

Autism is a neurological disorder and many people with autism show observable behaviors along with communication deficits (Center of Diseases and Control, 2012). Thirty-eight percent of people with autism have an intellectual disability and 24% are borderline in terms of having an intellectual disability (Center of Diseases and Control, 2012). One of the most common signs of someone with autism is atypical body

movement. Researchers have found that 59% of people with autism have body movement deficits (Dewey, Cantell, & Crawford, 2007). Many people with autism will walk on their toes, flap their hands, rock their bodies, position themselves in unusual ways and spin for sustained periods of time. They can engage in repetitive behaviors and have difficulty regulating their affect (Srinivasan, Park, Neelly, & Bhat, 2015). People with autism usually have some type of sensory processing disorder and may be either over or under sensitive to sound, textures, smells and temperatures (Bromley, Hare, Davison, & Emerson, 2004). The current DSM-5 has added 'hyper- or hyporeactivity to sensory input' to the criteria for an ASD diagnosis. Hyper- and hyposensitivity are described as atypical responses to any of the sensory modalities: vision, audition (hearing), touch, taste, olfaction, the vestibular system (balance), and activity level (American Psychiatric Association, 2013). Hyposensitivity occurs when a person is underwhelmed by the stimuli around them and seeks out additional sensory stimuli to supplement. Students with autism may show signs of having advanced visual or special skills, but often they have disorders in sensory responses especially with auditory input (Case-Smith & Arbesman, 2008). Signs of hyposensitivity can be the need to excessively touch things, listen to things at an increased volume, increase visual stimuli with fingers, hands or an object of choice, and/or the need to put objects into their mouth (Bijlenga, 2017). On the other hand, hypersensitivity is characterized as becoming overly uncomfortable at the slightest encounter with certain environmental stimuli (Lucker, 2013). A person who is hypersensitive to sound, for example, will have increased deficits in filtering out irrelevant auditory information such as the sound of a refrigerator turning on and off,

which may be viewed as auditory hypersensitivity to noise (Bijlenga, 2017). Speech pathology has focused on hyper and hyposensitivity in connection to speech development. What has been observed in this field is that some students may experience a blend of both hyper- and hyposensitivity (Lucker, 2013). These students may be overly sensitive to light, but not notice varying volumes of sound. If the brain is struggling to properly process sound they may be missing important language building opportunities and therefore fall behind in verbal development (Lucker, 2013). Research has shown that 70% of children with autism exhibit hypersensitivity to auditory stimuli, such as, (loud or unexpected sounds) (Bromley et al., 2004). Various sounds can be intolerable to children with autism, therefore it is important to find a way to manage auditory stimuli in daily life. Hare and Emerson (2004) discuss a possible intervention to lower hypersensitivity. They state that a barrier to reduce the level of auditory stimuli can be used such as silicone earplugs, earmuffs, and/or headphones to manage behavioral and emotional problems related to auditory stimuli (Bromley et al., 2004). Headphones can block some auditory stimuli by producing another auditory stimulus that is more regulating, such as music (Lepisto,Kuitunen, & Sussman, 2009).

People with autism can be extremely rigid about time, eating, dressing and with keeping a routine ("What Does Autism Look Like?", n.d.). This rigidity about their environment can cause students with autism to display disruptive behaviors not seen in typically developing children, especially when their routines are changed or if they are denied access to preferred items or activities (Reese et al., 2005). Because of deficits and

behaviors, these students generally need mild to significant educational supports in order to have academic and social success.

Need for Educational Services

The United States has put into law that every student is entitled to a free and appropriate public education in the least restrictive environment (PL 108-446, 2004). Typically developing students are generally able to achieve academic and social success with the standard public education model. For students to be successful academically, socially and in the future workplace, they must display the ability to maintain attention to tasks, communicate effectively, engage socially and participate in activities with their peers. There are several additional educational services that are required and have been deemed appropriate for students with autism in order to access their education and be included in the public school setting (Newschaffer, Falb, & Gurney, 2005).

Many schools are providing educational services for autism students below the age of three because the law states "to the maximum extent appropriate to the needs of the child, early intervention services must be provided in natural environments, including the home and community settings in which children without disabilities participate" (34 CFR §303.12(b)). Advanced screening methods have allowed for the identification of ASD for children as young as 12 months old (Lord et al., 2012) and research supports that early interventions improve outcomes for students with autism (Fernell et al., 2011). Early intervention can also promote communication skills (J. H. Park, Alber-Morgan, &

Cannella-Malone, 2011), motor skills, physical activity and socialization (Kecheson, 2017).

There are many different research-based interventions found to be effective for students with autism such as, but not limited to, functional communication training, social skills training, picture exchange communication, task analysis, and visual supports. Professionals such as speech pathologists, occupational therapists, physical therapists, and special educators may use these interventions to make progress for these students' deficits. Students with autism often have delays in their gross and fine motor skills (Green et al., 2009). Specifically, they tend to have impairments in their balance, their ability to walk and overall coordination (Manjiviona & Prior, 1995). Because of these delays, students with autism can receive services that aim to improve fine motor skills such as handwriting and gross motor skills such as walking and running. Students with autism also have difficulty communicating, in part, due to their language deficits (C. J. Park, Yelland, Taffe, & Gray, 2012). These language deficits and lack of communication may lead to undesirable behavior from students with autism because problem behaviors might be interpreted as a function of communication limitations (Reese et al., 2005). Speech therapy addresses many of these communication deficits by teaching skills that promote verbal, sign language and social skills in the school setting (Koegel & Koegel, 2006).

Depending on the level of need, students with autism may require multiple services and professionals to adequately learn, thrive and reach their goals in the school

setting. The use of music, and music therapy, is currently being researched as a method used to help improve skills in many of the deficit areas for individuals with autism.

Difficulties of Engagement for Students with Autism Spectrum Disorder

Because autism is a spectrum disorder the level of engagement that people with autism exhibit will vary. Students with autism may experience difficulty engaging in typical academic and social activities, as well as deficits in personal relationships. As previously noted, one area that greatly affects people with autism is the ability to engage, both in school activities and social interactions, as well as the capacity acquire language and communicate appropriately (Miller-Jones,2017). Current research into the area of language acquisition in people with autism revolves primarily around problems with receptive and expressive language skills (Miller-Jones, 2017). Expressive language is the ability to put words together to form a coherent sentence orally to express something, along with the use of gestures or signs, where receptive language enables an individual to comprehend what is communicated. In standard development, receptive language always comes before expressive—one can understand what is being said before they have the ability to speak it (Arciuli & Brock, 2014). In typically maturing children the development of symbolic and intentional language occurs between 9 and 12 months of age, and can be recognized as attempts at more coordinated communication behavior. For example, children might point shift or hold eye gaze, and have more clarity in attempts at oral communication (Arciuli & Brock, 2014). These behaviors signal the onset of joint attention (Mundy, Gwaltney, & Henderson, 2010). Dimitriadis and

Smeijsters (2011) call this impairment of expressive and receptive communication skills theory of mind, which involves understanding a variety of social situations, and knowing how to respond appropriately with self-regulation (Dimitriadis & Smeijsters, 2011). Language outcomes for students with autism can vary greatly from highly developed oral communication skills, to no language acquisition at all (Arciuli & Brock, 2014). The deficits that people with autism encounter can be mild or extensive and involve impairments in language, gestures, and pragmatics (conversational etiquette such as turn taking). Communication impairments most often appear at an early age, and are frequently mistaken for problems related to hearing (Arciuli & Brock, n.d.).

Experiencing a deficit in the area of communication can affect one's overall wellbeing, and lead to basic needs not being met (Dimitriadis & Smeijsters, 2011). For people with autism this can cause challenging behaviors that manifest as a communicative function (Durand & Carr, 1991) and occur as a form of protest or frustration in response to a failed attempt to communicate (Alexander, Wetherby, & Prizant, 1997). If communication needs are met by exhibiting challenging behaviors, this can lead to what Skinner calls operant conditioning which states that when a behavior is followed by a certain type of consequence, it is more likely to occur again and become a reinforcer (Skinner, 1992). Therefore, for students with autism a focus on communication skills and language acquisition is necessary in the educational setting. In fact, the National Research Council's Guidelines (2001) for educating children with autism state: "Appropriate social interactions may be some of the most difficult and important lessons a child with autism spectrum disorders will learn" (2001, p. 213) and

educational goals should include "social skills to enhance participation in family, school, and community activities" (p. 218). An inability to express oneself, and read social situations can lead, not only to a pattern of negative behavior, but a severe lack of ability to engage in both school activities and personal growth and development (Dimitriadis & Smeijsters, 2011).

Another area that can prevent a student with autism from being able to engage and learn in necessary school activities is the inability to participate in joint attention. Joint attention is when two or more people can take part and focus on the same thing cooperatively (Colombi et al., 2009). An average child is able to learn and share experiences with others through the process of joint attention, which leads to engagement (Adamson, Bakeman, & Deckner, 2004). Many traditional classrooms are designed in a manner in which children are expected to do group activities and learn together. Children with autism have difficulty with joint engagement and participating in shared experiences (Kim, Wigram, & Gold, 2008). A typical child shows signs of joint attention behaviors concurrently with their development of theory of mind (Leekam & Ramsden, 2006). As previously noted, theory of mind is someone's ability to understand other people's minds and also predict other's behavior. Over time, a person is able to develop theories and gain a better understanding of what people are feeling and thinking in given situations (Miller, 2006). As students with autism continue with school, social situations become more complex and these students may have difficulty adapting to the changing environment (Dettmer, Simpson, Myles, & Ganz, 2000). Joint attention skills promote higher functions of communication, social interaction, language development and they are an

essential step in a person's early development (Kim, Wigram, & Gold, 2008). Without a mature development of theory of mind a person may not be able to navigate social situations effectively.

Significant deficits in motor ability can have negative impacts on people with autism's ability to engage socially as the coordination and regulation of sensory and movement information is required for social interactions, speech communication, and participation in the environment (Robledo, Donnellan, & Strandt-Conroy, 2012). Motor planning is an essential skill for developing advanced motor functions, and gross motor skills (such as the movement and coordination of arms and legs), and students with autism display a generalized motor planning deficit. This deficit can include clumsiness in gait, and gross motor performance (Dewey et al., 2007). Several studies have found that between 80-90% of children with autism demonstrate some degree of motor abnormality, and that these deficits can have vast implications for communication and social functioning as these skills rely on the organization of sensory and motor responses (Donnellan, Hill, & Leary, 2013; Ghaziuddin & Butler, 1998).

Another deficit area for people with autism is the ability to imitate others. Imitation is when a person is able to observe and reproduce someone else's behavior (Rogers, Hepburn, Stackhouse, & Wehner, 2003). Delays in imitation are one of the signs of autism and the diagnosis of these delays can predict communication delays and problems with social communication (Vanvuchelen, Roeyers, & De Weerdt, 2011). Deficits in executive functioning are another underling factor in people with autism's inability to imitate what others are doing (Rogers, Bennetto, Mcevoy, & Pennington,

n.d.). Researchers have reasoned that because of deficits in these neurologically-based skills infants with autism are unable to copy modeled behavior which results in the lack of foundational development and impedes maturation of theory of mind (Rogers et al., n.d.). The lack of imitation awareness and skills has led to many students with autism being separated from their typically developing peers, as well as students with other disabilities (Ingersoll, 2010). Researchers have found that people with mild autism were able to imitate familiar movements, but when presented with novel movements they were severely impaired in their ability to imitate (Rogers et al., 2003). Imitation can be especially hard for a person with autism when it is presented as a demand (Koegel & Koegel, 2006). A person with autism might have extreme difficulty benefiting from an interactive lesson in the classroom when they are experiencing deficits in imitation along with shortfalls in joint attention. To have success academically and socially in the classroom, students with autism will require visual learning materials and reinforcements to gain and maintain their attention (Broun, 2004; Bryan & Gast, 2000).

Music and Autism

Music is a shared common ground across all cultures and appreciated by all people regardless of age, ethnic background and/or socio-economic status. Using music as an intervention for students with autism is still being investigated, but current research shows that music has a positive effect on the behavior and level of engagement in activities of students with developmental disabilities in many settings (Humpal, 1991). Incorporating music or sounds with rhythm during times of instruction have been shown

to decrease aggressive and overly disruptive behaviors for students with autism (Orr, Myles, & Carlson, 1998). These behaviors can be a reason why students with autism are not included in general education classes. If music can decrease the amount of problem behaviors it might simultaneously increase the amount of time a student can focus on positive interactions with peers or academics. Current research regarding the effect of music therapy on students with autism indicates that using music therapy during classroom activities can increase learning outcomes and levels of engagement in the area of social interactions and communication abilities (LaGasse, 2014). One study found that people with autism aged 5 to 22 "had stronger activations of the cortical speech and auditory areas when exposed to song" as compared to typically developing children (LaGasse, 2014). The study went on to state that the areas observed coincided with a greater activation of "frontal- posterior networks," suggesting that musical stimuli may more effectively engage people with autism (LaGasse, 2014). If processing abilities increase with the presence of music, then one might conclude that music can increase engagement and ability to learn in people with autism.

Emerging research on the topic of the effect music has on students with autism shows that music can help improve many areas of need such as joint attention, social skills, and an increase in positive behavior (Geretsegger, Elefant, Mössler, & Gold, 2014; Kim et al., 2008). Music therapy, which considers a child's individual needs and then designs a plan with creating, singing, moving to, and/or listening to music (American Music Therapy Association, 2012), has been shown to increase positive behavior and engagement, and strengthen the outcome of social stories when paired with music and

singing (LaGasse, 2014). Music therapy has also been shown to improve emotional regulation and understanding, social skills, and joint attention skills by acting as a motivator for eliciting attention because it promotes sustained awareness of peers, especially with the use of a musical instrument or toy in a play-based setting"(LaGasse, 2014). Kim, Wigram, & Gold, (2008) state that the positive effect of music on people with autism can be attributed, in part, to the fact that certain musical elements facilitate perceptual organization of auditory stimuli. Because people with autism experience sensory deficits, the natural outcome of ordering of auditory stimuli present in music aids in the organization of the sensory input they are receiving. In short, music helps them make sense of the input (Kim et al., 2008). If students with autism are able to organize their sensory input, they are able to better focus with their other senses, and direct their awareness towards joint attention or peer interactions (Kalas, 2012). This focused attention with the presence of music also helps students with autism participate in group interactions, play, or physical education activities (Carnahan, Musti-Rao, & Bailey, 2009).

Effectively encouraging and improving joint attention skills has shown to be a high priority in increasing levels of engagement in students with autism as it improves communication skills, language development and social interaction with peers and the utilization of music has been shown to benefit students with autism in this area (Miller, 2006). Current research indicates that improvisational music therapy is increasing levels of engagement in students with autism by engaging them with music and then facilitating joint attention behaviors and non-verbal social communication skills (Kim et al., 2008).

Improvisational music therapy involves a student making up music spontaneously by either singing, playing an instrument, or creating sounds with hands or feet. As the sounds are being made, a teacher or therapist would then use musical attunement to start making sounds with more meaning (Kim et al., 2008). Musical attunement involves a moment-to-moment response to the improvised music by listening attentively and then matching the beats or sounds the student is making until they can be guided into something more meaningful, such as a rhythm, beat, harmony or melody (Bruscia, 2012). When this is done, students with autism often understand that the sounds being made correspond with their own which encourages them to join in with, or initiate interaction with a teacher, peer, or therapist by further adding to or imitating the sounds (Kim et al., 2008). This happens because the sounds originate with the student and then turn into a more predictable pattern—essentially scaffolding their ability to engage in and create musical sounds with another person. One study suggests that this kind of interaction imitates early interactions between a mother and an infant due to the fact that it is focused on non-verbal modeling of a behavior (Heal & Hughes, 1995), due to the fact that pre-verbal infant interactions with a mother are fundamentally improvisational. For example, an infant will often make a sound or gesture and then the mother will respond by changing her tone, and then the infant will respond again by imitating her, and so on (Heal & Hughes, 1995). Children with autism have been shown to lack the ability to engage in this sort of creative social interaction with another person (Kim et al., 2008). By using response-evoking techniques, such as improvisational music therapy, that involve coordinated attention by creating fun and enjoyable musical sounds, the students'

focus of attention is drawn in, and the potential for joint musical engagement is introduced (Holck, 2004).

Physical education teachers often incorporate music during lessons and activities (Alderman, Beighle, & Pangrazi, 2006). Research suggests that when physical education lessons are paired with music containing lyrical instruction, students are more likely to engage in on task behavior (Edwards-Duke, Boswell, McGhee, & Decker, 2002). For students without disabilities, music has been shown to increase rhythmic ability as well as gross motor performance in a physical activity setting (Zachopoulou, Derri, Chatzopoulos, & Ellinoudis, 2003). There is limited research on the affect that music has on students with autism in the gross motor, setting but students with autism have shown to increase on-task behavior during physical activity lessons when music has been included (Dieringer, Porretta, Goodway, & Sainato, 2012).

For students with autism, strict routines, schedules and procedures play a large role in encouraging on-task behaviors in the classroom setting (Kern, Wolery, & Aldridge, 2007). Transitions throughout the day, such as the initial transition into the classroom, changing small groups, moving from one area of the classroom to another, or going outside and then coming back in can result in increased negative behaviors such as avoidance of task, elopement, or verbal and physical outbursts (Kern et al,. 2007). One study suggests that using music therapy in the form of an entrance song to greet students with autism can result in a smoother transition by easing students into the classroom, which, in turn, leads to more on-task behavior (Kern et al., 2007). The study described that by playing or singing the same song each morning, and pairing it with the steps

required to successfully enter the classroom (such as hanging a backpack in a cubby, sitting at the table, moving a name tag, etc…) the routine will become predictable and students will eventually be able to perform these tasks independently with the presence of the entrance song (Kern et al., 2007). Not only was using music to promote the morning routine successful in facilitating students to appropriately enter the classroom, but it also helped them to socialize with peers and engage in spontaneous play (Kern et al., 2007). One of the students showed a significant increase in the number of social interactions with his peers when the music was played compared to the absence of music (Kern et al., 2007).

Music can be used as a means to facilitate social engagement and communicative behaviors for students with autism. Social skills are extremely difficult to learn for people with autism, and educational objectives should be focused on developing social skills because they have lifelong implications that affect their family, community interactions, academic skills, self-worth and independence (Walton & Ingersoll, 2013). Music therapy interventions successfully promote social skill development for students with autism (Geretsegger et al., 2014). One of the ways that music therapy benefits social skills is by increasing students with autisms emotional engagement (Kim, Wigram, & Gold, 2009).

Disruptive and aggressive behaviors can contribute to students with autism's inability to engage in multiple settings. Rhythmic sounds can promote on-task and self-managing behaviors for students (Orr et al., 1998). A single subject study was done on a young girl with autism using an A-B-A-B reversal design as well as a metronome (rhythmic entrainment) to decrease aggressive and disruptive behaviors that she was

exhibiting during the school day. After 28 days of using the intervention during structured activities, the subject showed a significant decrease in problem behaviors(screaming) as a result of the rhythmic intervention (Orr et al., 1998).

Music therapy also strongly supports and facilitates inclusion of children with autism in various educational settings (Wilson, 2002). Music is a means of self-expression for all children, and allows for the opportunity to communicate and engage in social contact non-verbally (Nelson, Anderson, & Gonzales, 1984; Schumacher & Calvet-Kruppa, 1999). One study done with children with severe autism showed that the presence of music increased turn taking skills, and that the presence of negative stereotypic behaviors decreased (Thompson, McFerran, & Gold, 2014). Music therapy also helps to promote inclusion in the educational setting due to the fact that individuals with autism have been found to respond emotionally to music in a way that is similar to typically developing individuals (Ouimet, Foster, Hydekl, & Tyfon 2012). Another study found that using music therapy in an inclusive setting encouraged students with autism to participate in theatre activities. The study showed that because the music enabled students to choreograph movements and dance students with autism were able to watch, listen and then reproduce the behaviors of their typically developing peers with the use of rehearsals (Corbett et al., 2011). This study also noted that musical theatre, like modeling or social stories, may help individuals identify key social cues and develop skills in communication, movement, pretend play, and social interaction (Corbett et al., 2011). Additionally, the use of music in an inclusive educational environment can significantly impact memory and affect in students with autism (Janata, Tomic, & Rakowski, 2007).

Conclusion

This review investigated the literature regarding the effect that music has on levels of engagement and on-task behavior in students with autism. The research in this review reflected the difficulty that students with autism have engaging in academic tasks, and pointed to evidence that using music, in the form of music therapy, or to act as a buffer to distractions, can increase the amount of time, and depth in which a student with autism participates. These findings were relevant in both a special education setting, and an inclusive general education setting for academic tasks, and showed that music offered opportunities to increase success during academic activities, and students' ability to communicate with, and socialize, with peers.

The literature identified the prevalence of people with autism currently being one in 68 babies, with boys being affected at a rate of nearly five times more than girls. The studies presented discussed ways that people with autism often suffer from a variety of characteristics including deficits in the ability to communicate, intellectual disability, hyper and hyposensitivity, and rigidity regarding time, eating, dressing, and keeping with a schedule, among other things. Research-based interventions to address these needs including early intervention, functional communication training, and social skills training were described.

The review outlined specific areas in which students with autism have difficulty engaging and discussed deficits in language acquisition, communication, and social skills as being key underlying factors. The terms joint attention and theory of mind were

described in pointing out that these skills promote higher functions of communication, and the ability to navigate social situations effectively. The fact that people with autism often lack the ability to imitate others, which can further separate them from their typically developing peers was also presented.

The review then focused on music and its ability to increase on-task behavior in students with autism. The conclusion from studies was that music has the potential to increase processing abilities in students with autism by stimulating the posterior networks of the brain which can lead to higher levels of engagement. The work presented also emphasized that music can improve emotional regulation and understanding by acting as a motivator when used during group play, or when two students engage in playing instruments together. This kind of activity, or an activity in which improvisational music therapy is used, can increase a student's ability to engage in joint attention and positive social interactions with both teachers and peers.

Using music during transitional points during the day can increase levels of engagement by making routines predictable, and decreasing negative behavior; and studies indicated that students with autism respond emotionally in the same way that typically developing students do to music which can help with turn taking skills, and participation in inclusive school activities. Though there is a fair amount of literature regarding the effect music has on students with autism, this review unveiled an area that has the potential for far more inquiry that could lend a great benefit to students with autism, teachers, and peers. The purpose of this study is to determine if the use of

headphones with music playing increases the rate of efficiency in completing a structured task for a student with Autism Spectrum Disorder.

CHAPTER THREE: METHODS

Introduction

This was a single case research study using an alternating treatment design that compared the amount of time it took a student with autism to complete a structured task under two different conditions with one condition being completing the task while listening to music with headphones and the other being completing the task without the use of headphones and music.

Participant

The participant is one college-age student with Autism in a moderate-to-severe learning needs classroom at a state special education school located in Eureka California. The school's classes are designed to meet the special education needs of children and youth from ages three to twenty-two with an assortment of disabilities. The students at this school work on skills ranging from typical academics, independent home skills, community learning, as well as skills relating to future employment.

Prior to the study, after the question was formulated and the design was set, an observation and informal case review was done by the teacher in the classroom to determine a participant who fit the qualifications for the study. The participant chosen fit the criteria needed of his academic performance, diagnosis of Autism Spectrum Disorder, and his preference to listening to music with headphones during his free time. This

student also had a history of struggling to stay on task during math practice activities, and could benefit from the study if findings were positive.

Because the participant was over the age of eighteen, consent was obtained through an interview process stating the criteria of the study and asking the participant if he was willing to participate (see Appendix A for a sample of the participant's consent letter). The student participant has a tendency to be off-task during structured activities. For the student this can look like repeated attempts to look around the room rather than focusing on an assigned task. This results in the student requiring multiple prompts from the classroom teacher as well as the classroom staff in order for the student to complete assigned activities in a timely manner. This study will focus on the participant's rate at which they can complete their daily math practice worksheets when they have the use of headphones with music. The daily math practice worksheets consist of math problems involving mixed multiplication, subtraction, and addition math problems. He begins every math period with this independent math worksheet task before moving onto a structured math skills lesson.

The student participating in the study was diagnosed with Autism Spectrum Disorder and is considered to have moderate-to-severe disabilities. His ASD affects his cognitive skills, ability to communicate, presents sensory challenges, and impedes his attention skills. This student has been enrolled in the Northern California School since the age of 3. The student communicates through some sign language and is able to verbalize yes and no when given verbal yes or no questions. The student is proficient in his times tables up to twelve and can add and subtract with regrouping and borrowing. He is

generally in very good spirits and enjoys coming to school. He has near perfect attendance, having not missed a day of school in over 2 years.

Raw data from this study was used to create graphs, tables, and charts as a means of visually representing the results obtained from all treatments. Data was kept on a password protected school computer hard drive and copied onto a password protected USB drive. Data stored will be kept for 3 years and then destroyed by deleting all information on both the hard drive and USB. These precautions will be taken in order to protect the identity of the student and the integrity of the study.

Setting

The study was conducted in one setting before noon during the student's regular school day. The setting is in a moderate to severe special education classroom consisting of five other students, three Special Circumstance Aides as well as the classroom teacher. The classroom contained one row of tables, one row of desks, a bank of three desktop computers, and a cubicle desk in the back corner room for students who need help eliminating visual distractions. This student sits at the cubicle desk while working on his math worksheets.

Materials

Fourteen different math packets were used for the study. The math packets that were used consisted of three worksheets containing twenty-five math problems each. The first worksheet in the packet consisted of multiplication problems, the second worksheet

consisted of subtraction problems, and the third worksheet in the packet consisted of a mixture of 1 and 2 digit multiplication, subtraction, and addition problems. The packets were created using an online math worksheet generator. He was also given two pencils with cap erasers to record his answers with, and was seated at a desk with partitions on three sides (left, right, and front) to reduce visual distractions in the classroom, and increase focus on the activity. A 3 inch by 3 inch card with green on one side and red on the other was used to indicate when the student could begin working on the math packet. For the treatment phase an iPod touch playing Bach: Goldberg Variations, BWV 988 with a pair of wired red JBL E35 over the ear headphones were used. The music was chosen based on the student's preference for classical music.

Dependent Variables

The effect of the treatment condition on the students' rate efficiency while completing a structured task was measured by determining the elapsed time to complete the task from start to finish.

Independent Variables and Treatment Conditions

The participant completed the math worksheets under two different conditions during the course of the research. The first condition was the baseline condition in which the participant completed the structured task without the use of headphones and music and the second was the intervention condition in which the participant used headphones with music while completing the task. The structured task consisted of three math

worksheets that were at an independent level for the participant. Table I represents the protocol for the sessions without the intervention and Table II represents the protocol for completing the math worksheets with the use of headphones with music.

Experimental Design and Procedure

A single case alternating treatment research design was used to compare the amount of time taken to complete a structured activity during the two conditions. The single case research design was used because by repeatedly altering experimental conditions in the design there are many opportunities to determine if there were changes in performance due to the intervention (Kazdin, 2011). A total of 14 sessions were conducted with 7 phases using the no music protocol and 7 phases using the headphones with music protocol. Fourteen different math packets at the same ability level were created using the online math worksheet generator with each packet being assigned a number 1 through 14. Packets were assigned to the alternating treatments using a random number table to minimize the effect that variation of the math packets would have during the two different conditions. No treatment occurred during the baseline days. This phase was used to determine whether there was any difference in the time till task completion in the control condition. For this phase the participant was called to their assigned work area where the math packet, the three by three card with the red side facing up and two sharpened pencils had been previously placed there. The researcher ensured that the participant had a pencil in their hand. The researcher then said “go” while flipping the card to the green side and simultaneously hitting start on the timer. The researcher then

observed the participant until the completion of the math packet. When the participant finished the last problem the researcher then hit stop on the timer and recorded the date, phase and elapsed time for the task to be completed into the data log.

Intervention

During the intervention phase the student was called to their assigned work area where the math packet, a three by three card with the red side facing up and two sharpened pencils had been previously placed. The participant was given the headphones to put on. Once the headphones were secure the researcher pressed play on the iPod touch. The iPod was placed out of reach of the participant because of the participant's tendency to scroll through its applications. The researcher ensured that the participant had a pencil in their hand. The researcher then said "go" while flipping the card to the green side and simultaneously hitting start on the timer. The researcher then observed the participant until the completion of the math packet. When the participant finished the last problem the researcher then hit stop on the timer and recorded the date, phase and elapsed time for the task to be completed into the data log.

Inter-observer Agreement

A second observer was trained in the methods of observation, record keeping and data collection. The second observer ensured that the researcher followed the intervention and baseline protocols as well as monitoring and recording their own separate times for elapsed time for the task completion. 35% of the sessions were assessed for the inter-

observer agreement. The mean for the inter-observer agreement was 99%--precisely the same amount of seconds by inter-observer and researcher.

Treatment fidelity was ensured during the research study by the second observer assessing my application of procedures using a written protocol designed for both the treatment phase and control phase. For each student the protocol the observer would check either “Yes” or “No” to determine if proper procedures were being followed (see Appendix B and C for observation protocols). This was done for both the treatment phase and the baseline phase throughout 35% of the observation sessions. Inter-observer agreement obtained a frequency ratio by dividing the number of correct steps by the number of total steps times 100. The researcher followed the protocols 100% of the time.

Social Validity

Following the intervention, the participant was asked in an array of different work opportunities whether he would like to use the headphones with music or not. When given the option, the participant chose to listen to music with headphones 100 percent of the time. Whether he enjoyed listening to music rather than not or if he had generalized that the music helped him be more efficient with the task is unknown.

CHAPTER FOUR: RESULTS

The participant demonstrated an ability to work at a higher rate of efficiency when performing the task with the accompaniment of the headphones with music. In every session, the student performed at a higher rate of efficiency when the headphones with music condition was applied. In total it took the participant 5,104 seconds to complete all the worksheets throughout the 7 sessions of the “no music” condition with the average completion time being 729 seconds per packet. When using headphones with music the participant was able to complete all the worksheets over the course of 7 sessions in 4,104 seconds at an average rate of 586 seconds per packet. This represents an approximately 20% improvement in completion rates. The average rate of efficiency for the “no music” control condition was 243 seconds per worksheet page compared with 195 seconds per worksheet page when in the “headphones with music” condition. The mean amount of time it takes to complete the packet under both conditions is 658 seconds with a standard deviation of 87 seconds. The participant was able to complete a math worksheet page at an efficiency rate of 48 seconds faster when completing the worksheet in the “headphones with music” condition versus the “no music” condition.

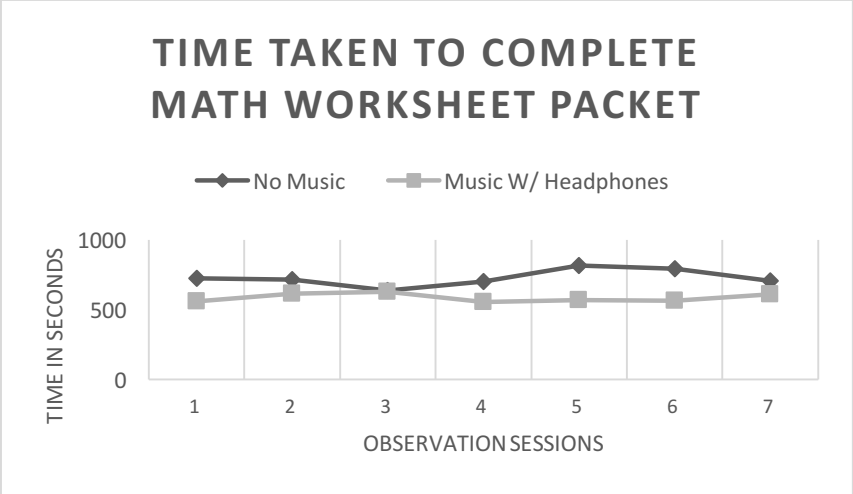

Figure 1 gives a visual description of the difference between the two conditions. The graph shows that the participant was more efficient with the math worksheet task during the music with headphones condition. The two conditions were rotated every other day school was in session. When completing the math packet without music and headphones the participant was less efficient.

Table 1 breaks down the individual sessions with the alternating treatments. The times are displayed in seconds. Each session represents two days in which the participant was involved in the alternating treatments.

Session#	**No Music**	**Headphones W/Music**
1	725	561
2	714	615
3	640	628
4	703	555
5	819	569
6	794	566
7	709	610

Table 2 shows the average rate of efficiency for completion of each packet. When utilizing the headphones with music, the participant was saving an average of 142.8 seconds on each packet. The participant gains 2.38 minutes of instructional time a day when using the headphones with music. Over the course a 180-day school year, this almost adds up to an entire instructional day.

Condition	**Average Time**	**Standard Deviation**
Seconds Per Packet WM	586.3 Seconds	30.2 Seconds
Seconds Per Packet W/OM	729.1 Seconds	59.9 Seconds

After running a t-test it shows that the T-Value is 5.63 and the P-Value is < 0.000. The results show that there is a real difference between performances in the two conditions with the probability of this occurring by chance being less than 1 in 1000. This data coupled with the probability of it occurring is significant.

CHAPTER FIVE: ANALYSIS AND CONCLUSION

Choice of Experimental Design

When someone is interested in comparing two or more interventions that apply to the same subject it is best to use a multiple treatment design (Kazdin, 2011). The purpose of the design is to make a claim about the effectiveness of the alternating treatments while minimizing the effect that the sequence of administration of the treatment has. For this study, the alternating treatment design was the best choice to consider given the comparison of the efficiency rate of a single subject with the two different variables of using headphones with music or not to complete a task. For this study, the research design provided the ability to implement the two alternating interventions every other day. With alternating the two treatment conditions, the effects from the treatments can be observed immediately (Kazdin, 2011).

Summary and Findings

The research question addressed in this study was: will the rate of on-task behavior in the classroom setting increase in a student with Autism Spectrum Disorder when given the use of headphones and music? After implementing the treatment of headphones with music, the short answer to this question appeared to be: yes. In every session the student was able to perform at a higher rate of efficiency when the headphones with music treatment was applied. Without the treatment it took the student 5,104 seconds to complete all the worksheets assigned throughout the 7 sessions of the

"no music" condition. With the headphones and music condition the participant was able to complete all the worksheets over the course of 7 sessions in 4,104 seconds. This demonstrates that the student was able to complete a math worksheet page at an efficiency rate of 48 seconds faster when completing the worksheet in the "headphones with music" condition compared to the "no music" condition. This means that with the music and headphones treatment the student was able to complete the math worksheets at a rate of 20% faster than without. Though this percentage breaks down to an average of 2.38 minutes of instructional time gained per day, over the course of a school year this amount of time adds up to over six hours of instructional or practice time in the classroom.

Social Validity

The general outcome of the study seemed to have a positive effect on the student, and he has since expressed a desire to listen to music while completing other practice work in the classroom. Data would need to be taken to present conclusive evidence; however, informal observations done by the SDC teacher, aides, and support staff suggest that this student's overall on-task behavior and rate of efficiency has increased since the study's conclusion with the use of headphones and music while completing work in the classroom.

Discussion

On-task behavior in the classroom is a skill needed by all students, ranging from typically developing students to those with severe disabilities, in all learning environments, from a general education campus to a separate state school. Students who are unable to complete work in the classroom (or are off-task) tend to not only loose educational benefits personally, but affect the educational benefits of those around them. They will often take time from the classroom teacher and attract the attention of other classmates. This may then lead to several students in the classroom being off-task or distracted. This takes even more time from the classroom teacher and support staff. For students to be successful academically, socially and in their future workplace, they must display the ability to maintain attention to tasks, communicate effectively, engage socially and participate in activities with their peers (Newschaffer, Falb, & Gurney, 2005). For students with ASD, level of engagement, both academically and socially, can be what prevents them from inclusion in a less restrictive environment (LRE) with typically developing peers (Miller-Jones, 2017). This information, coupled with my experience working with students with Autism spectrum disorder ranging from mild to severe is what led me to the development of my research question.

The question I posed at the start of this study was whether the use of music and headphones would increase on task behavior and rate of efficiency in a student with ASD. This was measured by measuring time of completion with and without the treatment. What I came to find was that the student was able to complete the task at a

higher rate of efficiency (in less time) with the treatment than without the treatment. Across all of the trials the participant was able to complete work at an average rate of 586.3 seconds faster with the headphones and music compared to the control condition. These results indicate that the presence of music enables this student to focus on the task at hand more efficiently, and complete work without distraction.

Though this study focuses on only one participant, this student's characteristics are in line with what is typical of people with ASD. Without the presence of music this student was easily distracted by both visual and auditory stimuli, whether that be someone walking by him, a noise made by another student, or other typical classroom noises, etc.. When the music and headphones were present he seemed to generally enjoy wearing the headphones, and the time it took him to move from completing one problem to completing the next decreased (this was the time the student would become the most distracted during math practice work (prior to the experiment).

These findings are consistent with research being done currently on levels of engagement in students with ASD when music is present. Studies suggest that with the presence of music students with ASD are able to engage in Joint Attention, the ability to focus on an activity with another student (Geretsegger, Elefant, Mössler, & Gold, 2014; Kim et al., 2008), social interactions and communication with other students, and engagement in both social and academic activities (LaGasse, 2014). Music has also been shown to be beneficial in a therapeutic setting and can be used with students who also have social-emotional needs (Holck, 2004). Considering this literature, coupled with the

data garnered from this study, the evidence suggests that music had an overall positive effect on students with ASD.

Questions that remain to be answered revolve around whether the style of music has an effect, and whether it is more beneficial to listen in headphones or as a whole group.

Limitations of the Study

One limitation to this study may be the participant's overall mental, physical, and emotional wellbeing on any given day. Some of these factors may include, but are not limited to, whether or not the participant ate breakfast, how the bus ride to school went, factors at home, etc.. As highlighted in the literature review, individuals with ASD can be greatly affected, or become dysregulated, by changes in routine, denial of preferred activities or items, changes in their environment, etc.. (Reese, Richman, Belmont, & Morse, 2005).

Another limitation to this study has to do with the relationship between the student with ASD and the researcher. I am the classroom teacher as well as the researcher. Historically this student was already used to following directions given by me, and had time over the school year to become familiar with my classroom routines and procedures along with completing tasks assigned by me on a daily basis. Eliminating the teacher-student relationship would help to reduce the threat of internal validity.

Another limitation to the study was that other students and support staff were present in the classroom during the trials. As with many classrooms, there were

unpredictable sources of auditory or visual stimuli that could have led to distractions. Being that the student was in a cubicle with partitions this limited the amount of stimuli, but did not eliminate all sources of possible environmental distractions.

Selection bias is also a limitation that needs to be addressed. As stated previously this student was chosen because of his academic performance and preference to listening to music in his free time prior to the study. Another participant may not have had a preference for listening to music and this could have resulted in different outcomes due to the sensory challenges of individuals with ASD. The willingness to listen to music while wearing headphones cannot be generalized to all individuals with ASD. This student also already had the skills to complete the math packets that were presented to him. Another task or activity may have had a different effect on the completion time and level of engagement.

It is difficult to generalize the results across all people with ASD in different settings due to the fact that Autism is a spectrum disorder that affects individuals in different ways. This study was conducted in a single setting. For another study, a multiple subject research design with more subjects, along with a broader range of people on the Autism Spectrum, would be needed in order to generalize results and garner more conclusive findings surrounding the effectiveness of the treatment.

A final limitation is that this study took place over a three week period of time. This is a relatively short term study. Replicating this research over a longer period of time with a different participant, and/or task, might help in determining whether the

intervention was effective in increasing the rate of efficiency (time on task) in a student with ASD.

Implications for Future Research

Though the outcomes of the study were beneficial for the participant, providing students with a cubical, headphones, and music may be difficult to duplicate in any classroom setting. Due to the cost of materials this may be unattainable for classroom teachers, and the ability to monitor if a student is listening to music or not may be difficult when student and the teacher are unable to be in a one-on-one setting. Previous research noted in this study indicated that using music as part of a whole group activity could boost levels of engagement and social interaction in students with ASD (LaGasse, 2014). Future research focusing on whole group intervention, especially in a setting where students with ASD had more of an opportunity to interact or work together with typically developing peers, may be beneficial.

Exploring the effect that music has on levels of engagement during structured activities with other students, such as PE or group work activities, may be warranted as well in order to compare the research focused on joint attention and social interaction with the research based on on-task-behavior. This would allow researchers to examine whether music is beneficial to student success in more areas of the school environment when coupled with opportunities for social interaction.

Research focusing on other forms of structured sound, (such as ambient noise, waves, animal sounds, etc…) may need to be conducted in order to determine if it is in

fact the music that is increasing the rate of task completion or if it is the absence of noise due to headphones that helps to increase focus on a task. For this, researchers may want to conduct a study similar to this one where the lack of noise (noise canceling headphones) is used rather than any noise at all.

Finally, looking at this study over a longer period of time, with more participants, and a broader range of settings would be beneficial in answering the important question of whether these results could be generalized among students across the Autism Spectrum, and across the wide variety of settings that students with ASD may be in.

Implications for Educators

As educators we have an obligation to meet the needs of individual students and see each child's specific strengths, characteristics, and weaknesses to provide an equitable learning experience for all students. This is no different for students with ASD. Each comes to the classroom with their own individual, and very specific, learning needs. These students often times require an individualized approach to learning that is outside of what the typical classroom often has to offer. This means educators, especially those who work with students with ASD, need to constantly be looking for ways to teach in a highly individualized and differentiated way to make sure students are meeting their full potential in the school setting. Providing them with accommodations to increase focus, such as music with headphones that may decrease distractions around them and increase levels of engagement, may be exactly what they need in that moment to be successful.

When considering the success of students, both instruction time and daily practice skills are required to maintain previously learned skills. If a student can get through a task at a faster rate with the use of music, this will leave more instructional time open in the future and more time for possible re-teaching of the material. When a student is on task this also leaves the teacher, or aides, in the room free to assist other students who may require academic assistance. By increasing the level of engagement of one student in the room, you may be increasing the educational benefit of the rest.

In my experience as an educator on both a GE and Special Education-only campus, I have seen teachers be apprehensive to allow students to listen to music without being able to monitor what they are listening to. While this is a valid concern due the accessibility of inappropriate music for school, teachers may need to consider how much the benefits of allowing individuals in the classroom to listen to music with headphones may outweigh potential harm. If music can increase level of engagement and, in turn, the ability for students with ASD to be included in a less restrictive environment, it may be worth spending time to make sure students are taught clear guidelines regarding the use of headphones in the classroom.

Final Thoughts

Students with ASD face a myriad of challenges when presented with a typical school day. These may range from completing classwork to interacting with others on a basic level. Students with ASD are benefitted by teachers and support staff who have specific training and use researched based teaching methods to help students work

towards making progress on their academic and social goals. This task becomes more complex when working with those on the more severe end of the spectrum who may lack the ability to communicate their basic needs. In working with the participant of this study, who, lacks higher level communication skills but will communicate preferences via pointing and/or yes or no responses, it became clear that this research was important for more than the data collected at the end of the trials. After working with this individual during the study, he began expressing a preference towards listening to the music with headphones while completing work other than his math packets. This showed me that the study benefited the student in more than one way. First, he was able to complete tasks as a higher rate of efficiency, which gave me more instructional time with him to work on other specific skills. I would argue more importantly, it allowed this student to feel a sense of agency in the classroom that he may not have otherwise been able to attain. Being that this student has severe communication deficits, he does not have many opportunities to make decisions for himself and express his individuality. In doing this study I found that it benefitted him in the sense that he seemed to feel more successful at school, and also had an opportunity to express his needs and preferences as a learner, which, in my opinion, is invaluable to have a sense of control over his own education.

Finally, findings with single case research studies can be significant, but more-in depth studies need to follow in order to strengthen the validity of the results (Kazdin, 2011). What my research does reveal is that with this specific student their efficiency

while doing a task can improve with the use of music and headphones. This efficiency can lead to more time to meet educational goals.

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APPENDICES

Appendix A

Informed Consent

Would you like to do a study involving math and music?

Participant's Response:

My name is Dustin Bradshaw and I am doing this study as a researcher for the Master's in Education program at Humboldt State University. I will sometimes ask you to listen to music while you do your daily math practice worksheets. The reason for doing the study is to see if listening to music affects someone with autism while they work on an activity. Is that ok with you?

Participants Response:

Is it ok if I time you while you do your math worksheets?

Participant's Response:

If you would like to do this, then you will wear headphones that play classical music during your usual math practice time every other school day. The other days you will be doing your math worksheets without music. I will then record how long it takes you to finish your worksheets. Is this something you would like to do?

Participant's Response

If you agree, then we will do this activity every day during your math practice time for three weeks. You can stop at any time if you would like. Is this all right with you?

Participant's Response

You can say no to this activity at any time. There are no risks if you decide to participate in the study. If you decide to participate you may end up doing your math practice worksheets a lot faster than when you started. Any information that is collected in connection with this study and can identify you will remain confidential.

The information we collect will be kept in a locked cupboard in the classroom and it will be shredded after 3 years. If you have any questions with doing this study, please let me know. If you have any concerns with this study or questions about your rights as a participant then contact the Institutional Review Board for the Protection of Human Subjects at irb@humboldt.edu or (707) 826-5165.

Your signature below indicates that you are at least 18 years old, and have understood the information read to you above, that you willingly agree to participate, and that you understand that your participation is voluntary and can stop at any time.

Signature Date

_____ _____

Appendix B

Headphones With Music Protocol			
		YES	NO
1	Retrieve the math packet with the randomly assigned number that corresponds with the day.		
2	Place the packet on the participant's desk.		
3	Place two recently-sharpened Ticonderoga #2 pencils with cap erasers on the participant's desk.		
4	Place the red and green card on the participant's desk with the red side facing up.		
5	Call the participant over to their work area.		
6	Give the participant the headphones to put on.		
7	Ensure the participant has a pencil in their hand.		
8	Hit "play" on the iPhone's "Bach" playlist.		
9	Flip the card to green and say "go" while simultaneously hitting the "start" button on the iPad stopwatch function.		
10	Maintain observation of the participant during the task.		
11	When the participant finishes the third worksheet, immediately press "stop" on the iPad stopwatch function.		
12	Record the date, time, and treatment for the task.		

Appendix C

No Music Protocol			
		YES	NO
1	Retrieve the math packet with the randomly assigned number that corresponds with the day.		
2	Place the packet on the participant's desk.		
3	Place two recently-sharpened Ticonderoga #2 pencils with cap erasers on the participant's desk.		
4	Place the red and green card on the participant's desk with the red side facing up.		
5	Call the participant over to their work area.		
7	Ensure the participant has a pencil in their hand.		
9	Flip the card to green and say "go" while simultaneously hitting the "start" button on the iPad stopwatch function.		
10	Maintain observation of the participant during the task.		
11	When the participant finishes the third worksheet, immediately press "stop" on the iPad stopwatch function.		
12	Record the date, time, and treatment for the task.		