2020

The effect of Music Attention Control Training (MACT) for pre-adolescents with Autism Spectrum Disorder

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THE EFFECT OF MUSIC ATTENTION CONTROL TRAINING (MACT) FOR PRE-ADOLESCENTS WITH AUTISM SPECTRUM DISORDER

By

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A Thesis Submitted to the

Graduate School

In Partial Fulfillment of the

Requirements for the Degree of

MASTER OF ARTS

Conservatory of Music
Music Therapy

University of the Pacific
Stockton, CA

2020

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ACKNOWLEDGMENTS

I wish to express my sincere gratitude to Dr. Feilin Hsiao for her hours of patience and guidance while I navigated graduate school over the last three years. Her efforts have truly made me enjoy research and teaching. Her dedication and passion towards her students have taught me so much about compassion and understanding as an educator. I thank Dr. Eric Waldon and Dr. Rachelle Hackett for their encouragement and mentorship in the development of this study. I never thought I would find another place to call home, however, the professors in the music therapy department have really made my time here feel like family.

THE EFFECT OF MUSIC ATTENTION CONTROL TRAINING (MACT) FOR PRE-ADOLESCENTS WITH AUTISM SPECTRUM DISORDER

Abstract

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2019

The purposes of this study are to investigate the effect of the Music Attention Control Training (MACT) on three types of attention (sustained, selective, switching) in pre-adolescents (10-14 years old) with Autism Spectrum Disorder (ASD) and to identify the impact of the level of severity (mild, moderate, severe) on changes in attention scores. This modified replication study included 23 participants randomly assigned to treatment and control group stratified based on severity of ASD. Significant results via two-tailed paired-sample *t*-test ($p < .10$) indicated significant positive trends with the treatment group for the 3 out of 4 subtests of selective attention: Hector Cancellation, Hector-B Cancellation, and Hecuba Visual Search; 1 out of 4 subtests of sustained attention: Sustained Attention Response Test (SART); and the single subtest of switching attention: Red & Blues, Bags & Shoes (RBBS). Results call for modifications to further support the role of MACT on attention skills with pre-adolescents with ASD. Implications for future research and contributions to clinical practices in music therapy are discussed.

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CHAPTER 1: INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder associated with social-communication deficits, as well as restricted and repetitive interests and behaviors (American Psychiatric Association, 2013). Among other symptoms, children with ASD frequently show differences in several aspects of attention (Burack, 1994; Meindl & Canella-Malone, 2011; Reed & McCarthy, 2012; Yerys et al., 2009). Attentional processes are prerequisite to the development of higher cognitive functions; therefore, these attentional deficits may prevent children with ASD from obtaining optimal benefits for therapies or educational interventions and may interfere with the development of social and communication skills. Attention can be separated into three categories: sustained, selective, and switching. Sustained attention is the ability to focus on a stimulus for an extended period of time, selective attention is being able to tune out other stimuli while focusing on one and alternating involves shifting focus from one stimulus to another stimuli.

Empirical evidence shows that children with ASD frequently demonstrate difficulties with different types of attention, including sustained, selective, and switching. In studies of sustained attention, children with ASD appear to remain fixated on a particular stimulus while ignoring other stimuli more so than do typically developing (TD) peers and peers with other disabilities due to sensory over arousal, as well as having perseverative behaviors and interests (Landry & Bryson, 2004). This skill allows individuals to focus on one task to completion.

Early research found that for adults with ASD, selective attention is compromised by the presence of distractors compared to those adults without ASD (Burack, 1994). Recent research also reported that when compared to adults without ASD, adults with ASD show longer reaction

times for correct responses and perform less accurately with distractors on visual selective attention tasks (Remington, Swettenham, Campbell, & Coleman, 2009). In addition, individuals with ASD have deficits in alternating attention. For example, children with ASD display poor performance in situations where they are required to switch attention with the visual modality (Yerys et al, 2009), as well as between different modalities (e.g., visual and auditory stimuli) (Reed & McCarthy, 2012).

Attentional deficits in children with ASD may interfere with the development of higher cognitive functions and prevent them from receiving the benefits of educational interventions. All types of attention contribute to the developing system of behaviors and responses that allow for greater self-regulation of thought, behavior, and emotion (Posner & Rothbart, 2000). Particularly, attention acts as a filter to select and maintain relevant information, in order to process, memorize, and then acquire that information (Posner & Rothbart, 2005).

In spite of their attentional deficits, however, research has demonstrated that children with ASD possess a musical sensitivity and a perceptual preference for music which may facilitate attention to music stimuli (Blackstock, 1978; Frith, 1972; Thaut, 1987). Thaut (1987) found that children with ASD have a significantly longer attention span for music stimuli than TD children. Furthermore, children with ASD maintained attention longer with auditory stimuli than with visual stimuli. Attention to music can also enhance attention to various cognitive tasks. More recently, Mahraun (2004) found that children with ASD perform significantly better on a sustained attention task such as while listening to background music or rhythmic patterns than without the music stimuli.

Neuroscientific research via brain imaging demonstrates that an overlap exists between brain areas that regulate attention and process musical stimuli. Findings regarding these shared

brain areas suggest that perhaps music may capture a listener's attention and subsequently facilitate general auditory attention. Activation of overlapping brain areas through music-based attention control training could strengthen attentional skills. Based on research findings from cognitive rehabilitation (e.g. Mateer 2000; Sohlberg & Matter 1987, 1989), Music Attention Control Training (MACT) is a Neurologic Music Therapy protocol (Thaut, 2005) specifically targets improving attention skills in individuals with neurological deficits or damage (e.g. Traumatic Brain Injury, Stroke, etc). MACT includes structured active musical exercises involving precomposed performance or improvisation in which musical elements cue different musical responses to practice focused, sustained, selective, divided, and alternating attention functions (Thaut, 2005). MACT utilizes the same attention process structure to train the clients in focusing, selecting, sustaining, alternating, and dividing attention and found the results suggest that children with ASD can improve their attention skills using the MACT protocol.

Needs for the Study

Although the findings indicate that music can elicit sustained, selective, and alternating attention, there has only been one published pilot study on the effect of MACT on individuals with ASD (Pasiali & LaGasse, 2014). Although they found positive trends, there is a need for a replication study with modifications such as a larger sample size, randomization, and control group so the results can be more confidently generalized to the target population and include a detailed procedure so clinicians can easily use the interventions within their own practice with reliable attention outcomes.

The findings from this study will further the understanding of the relationship between MACT protocol and attention in clinical populations who have attention deficits, specifically pre-adolescents with ASD. Along with professionals, this study will also help family members

and caregivers of children with ASD understand how MACT can facilitate attention. It will also support the use of music as an attention assessment stimulus. For instance, music therapists as well as other professionals who work with children with ASD can use a music-based treatment to confidently improve attention skills with reliable results. Music therapists will also be able to select appropriate music-based interventions according to a client's severity of ASD or attentional deficits. In contrast, complex distracting auditory stimuli against target sounds might further challenge clients with mild attention deficits. This study will help build upon a scientific foundation for the use of MACT protocol to improve attention.

Purpose of the Study

The purpose of this modified replication study is to investigate the effect of the MACT protocol on different types of attention (sustained, selective, attentional control/switching) skills in pre-adolescents (10-14 years old) with ASD. It aimed at strengthening the foundation for the use of music to assess, address and improve attention deficits and the development of music-based intervention for facilitating attention in children with ASD. Specifically, to measure the changes in attention skills, to compare the differences between the treatment and control groups, and to identify the impact of severity of ASD (mild, moderate, severe) on changes in attention scores.

CHAPTER 2: LITERATURE REVIEW

To understand the effect of MACT protocol on attention skills in pre-adolescents with ASD, this chapter focuses on 1) neuroanatomical mechanisms and attention for ASD 2) types of attention; 3) neuroanatomical evidence of attention 4) neuroanatomical evidence of attention and music; 5) music and attention in ASD; and 6) Music Attention Control Training (MACT).

Neuroanatomical Mechanisms and Attention for ASD

The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013) indicates that individuals with Autism Spectrum Disorder as having possibilities of "abnormalities of attention (overly focused or easily distracted)." Sanders, Johnson, Garavan, Gill, and Gallagher (2008) proposed that the difficulties in attention skills might be due to atypical brain connectivity (atypical intensity and regional localized activation) and long-range under connectivity (inability of neural units to activate effectively) in individuals with ASD. Individuals with ASD show increased error rates in alerting and executive control, which is accompanied by lower activity in the mid-frontal gyrus and the caudate nucleus for alerting and is affected by the absence of significant functional activation in the anterior cingulate cortex (ACC) for executive control. The greater behavioral deficiency in executive control is also correlated with less functional activation of the ACC. These findings in alerting and executive control of attention in ASD suggest core attentional deficits (Fan et al. 2012). Rahko, et al. (2015) states that maintaining sustained attention in ASD produces reduced activation in bilateral striato-thalamic regions, left dorsolateral prefrontal cortex (DLPFC) and increased activation in precuneus compared to typically developing (TD) controls. Spatial attention skills which activate the frontoparietal network of brain areas has been found to have

deficits in adolescents with ASD. The different cortical activations affect the individual's ability to process and response appropriately to various environmental stimuli (Belmonte, 2000; Belmonte, Allen, Beckel-Mitchener, Boulanger, Carper, and Webb, 2004). The lack of efficient processing may be observed in attention focused on meaningless or irrelevant stimuli. The attentional deficits may prevent children with ASD from receiving the optimal benefits from therapeutic or educational interventions and may interfere with the development of other social and communication skills.

Types of Attention

Attention is the part of the mind that is used to process one stimulus over another (McDowd, 2007). Attention is thought of as a spotlight, where attention illuminates a stimulus and that area is processed the most efficiently. Specifically, auditory attention is the ability to focus on specific sounds and process them to obtain meaning (Kalinli, Sundaram, & Narayanan, 2009; Wrigley & Brown, 2004). Attentional processes are necessary for the development of higher cognitive functions, such as memory, executive function, communication, and executive control. Attention contributes to the developing system of behaviors and responses that allow for greater self-regulation of thought, behavior, and emotion (Posner & Rothbart, 2000). Attention also acts as a filter to select and maintain relevant information to process, memorize and acquire that information (Posner & Rothbart, 2005). Attention training appears to generalize to other tasks (Rimmele & Hester 1987). The main types of attention addressed in this study include sustained attention, selective attention and attentional control or switching attention (McDowd, 2007).

Sustained Attention

Sustained attention (also referred to as alerting) is defined as the maintenance of focus to complete a task over a prolonged period of time (Lezak, et. Al, 2012). It also consists of vigilance, arousal, and the ability to sustain attention to a specific stimulus. Sustained attention is important in tasks required effortful control, so internal or external distractions do not interfere with the task at hand. Sustained attention is usually measured by monitoring a long stream of rapidly presented information for the occurrence of a rare target. If the focused attention wains, the target information will be missed, and as a result, increases with time on the task (McDowd, 2007).

Selective Attention

Selective attention, also referred to as executive control/focused is defined as the processing of one source of information and ignoring other sources of information available in the environment. It provides a mechanism for determining which sounds will be most thoroughly processed and brought to awareness, to the exclusion of others (McDowd, 2007; Strait & Kraus, 2011). An illustration of this concept is the "cocktail party" phenomenon. The cocktail party phenomenon demonstrates the ability to selectively attend to one speaker among other conversations and background noise at a party (Cherry, 1953). Maintaining selective attention relies on conscious effort allocated to a specific stimulus, which is goal-oriented (McDowd, 2007).

Selective auditory attention is vital to building cognitive, behavioral, and language capabilities by improving language-related skills (vocabulary, reading abilities) (Forgeard et al., 2008; Forgeard, Winner, Norton, & Schlaug, 2008). It allows for the ability to perceived speech in various background noise (Hittner, & Kraus, 2011; Strait & Kraus, 2011), and is crucial to the

efficient use of cognitive functions, such as executive behaviors and working memory (WM) (Bialystok & DePape, 2009).

Alternating Attention

Switching also known as attentional control, alternating attention, or orienting, allows a person to shift focus among two or more stimuli. It is the selection of and switching between specific information in the environment by disengaging, moving to a new focus, and reengaging. When switching, only one source of information is attended to at any given moment in time, but the focus may rapidly switch back and forth between multiple sources. Switching from one task to another requires the individual to remember the status of one task while performing the other. This is so when the attention is switched back to the first task, it can be resumed with efficiency. This attention also requires resetting task priorities with each switch (McDowd, 2007).

Neuroanatomical Evidence of Attention

There are some human behaviors whose function can be specifically localized in the brain, however, there is not a single brain area that is responsible for attention because of its multidimensional complexity. Peterson and Posner's (2012) theory of attention describes three networks in the attentional system: alerting, orienting, and executive. It is stated that the alerting network is involved in the maintenance of task vigilance and is lateralized to the right hemisphere. The orienting network prioritizes sensory input, selecting a brain modality or location. The parietal areas, frontal, and posterior areas are engaged in the orienting network.

The executive network is engaged in target detection and activates connections from the midline cortex and the anterior cingulate cortex (ACC) citation. Executive control is based on two networks: cingulo-opercular control network which is engaged in task maintenance, and the frontoparietal system involved in task switching and initiation. Experience also influences these

attentional networks, and aids in support for rehabilitation of cognitive functions, including attention (Peterson & Posner, 2012). Klingberg (2011) stated that there were improvements in executive function and attention-related brain areas after attention training studies.

Neuroimaging studies, including electroencephalogram, magnetoencephalogram (MEG), and functional magnetic resonance imaging (fMRI), found that auditory attention has shown clear neuronal responses in the primary auditory cortex and secondary auditory cortical regions (Ahveninen et al., 2006; Brechmann & Scheich, 2005; Zatorre, Mondor, & Evans, 1999). The superior and superior-lateral surfaces of the temporal lobe are also activated in response to auditory stimuli. Auditory attention also activates the frontal and parietal systems, left precentral gyrus, the right posterior parietal cortex, and the left superior and the right temporal cortices (Shomstein & Yantis 2004, 2006).

During an auditory discrimination task, Pugh et al. (1996) found that listeners who were asked to attend to either similar or confounding auditory stimuli, showed activation in the posterior parietal attention system and the superior and inferior frontal regions of the brain. Additional research conducted in visual and auditory domains saw activation in the parietal and frontal cortices as well as the anterior cingulate cortex (ACC) in attention (Cohen, 1993; Pugh et al., 1996).

While attention to tasks activate selective areas of the brain, auditory attention involves network of auditory cortical areas and subcortical structures, such as the basal ganglia and the cerebellum. Furthermore, attention to auditory stimuli also integrates with the generalized multisensory attentional network that includes the frontal, parietal temporal, and anterior cingulated cortical regions. Zatorre, Mondor, and Evans (1999) found that participants undergoing positron emission tomography (PET) completed several listening tasks that required

detection of pitch. The results demonstrated activation of the bilateral auditory cortex, the right superior parietal region, the right dorsolateral frontal region, and the right premotor regions. It also increased activation in the inferior frontal and parahippocampal areas. Therefore, selective auditory tasks engage the specialized network of the right hemisphere regions (right parietal, frontal, and temporal cortices). Knox and his associates (Knox et al. 2003) have been foremost in the investigation of using music to improve attention. Their studies have demonstrated that alternating attention can be improved with music therapy.

Neuroanatomical Evidence of Attention and Music

There is a large of body of research in musical attention that establishes the role of rhythm in tuning and modulating attention in music. Rhythmic patterns drive attention focus by interacting with attention oscillators via coupling mechanisms. There is evidence for divided attention mechanism in song between processing of lyrics and processing of music (Bonnel, Faita, Peretz, & Besson, 2001). In a study with Coull et al. (2004) it was found that music regulates attention and arousal in the brain in a complex, bilaterally distributed process.

Zhu et al. (2009) found larger brain activation patterns with culturally relevant music as opposed to non-culturally relevant music. Flowers (2001) found that when participants focused on preferred music with distractors, they reported fewer distractions than when they had non-preferred music. There was an inverse correlation between preference and distraction. Cultural relevance, familiarity, and preference are important aspects in music meant to increase attention because they increase the saliency of the music for the participant. Strait and Kraus (2011) found that musical training decreased prefrontal neural variability during auditory selective attention tasks. Variability in the activation of prefrontal regions is associated with decreased attention task performance. Musical training also supported the development of higher-level cognitive

mechanisms that might improve auditory processing. The effect of musical training on the rate and accuracy of processing auditory information, music may have therapeutic potential to have remedial effects for individuals with neurodevelopmental deficits (Kraus & Chandrasekaran, 2010; Strait, Kraus, Parbery-Clark, & Ashley, 2010).

Selective attending to specific aspects during music listening engages the superior parietal lobes (Satoh, Takeday, Nagata, Hatazawa & Kuzuhara, 2001). Sustained attention to music is processed in the parietal and dorsolateral prefrontal cortex (Ortuño et al., 2002). Attention to music is also processed in the same areas that process non-musical attention. The areas like the temporal lobe (the superior temporal gyrus), the parietal lobe (the intraparietal sulcus), the frontal lobe (the precentral sulcus, the inferior frontal sulcus and gyrus), and the frontal operculum are active during both selective and holistic listening to music (Janata, Tillmann & Bharucha, 2002).

The anterior cingulate cortex is often activated in the processing of attention skills (Cole, Young, Friewald & Botvinick, 2009; Davis, Hutchison, lozano, Tasker, & Dostrovsky, 2000; Koelsch, 2010; Petrovic & Ingvar, 2002). Other research confirms the attention-based role of the ACC during music listening (Sridharan, Levitin, Chafe, Berger, & Menon, 2007). The ACC also is activated when using selective attention during music listening tasks (Satoh et al, 2001). There are several brain imaging studies that suggest that music perception activates both hemispheres of the brain. It engages specific neural processes corresponding to the basic components of music and musical elements (Bengtsson et al., 2009; Platel et al., 1997; Popescu, Otsuka, & Ioannides, 2003), dynamics (Rinne et al., 2007), form (Koelsch, 2005; Sridharan et al., 2007), pitch (Platel, 1997; Satoh, Takeda, Nagata, Hatazawa, & Kuzuhara, 2001; Trainor et al., 2002), melody

(Janata et al., 2002; Sridharan et al., 2007; Trainor, McDonald, & Alain, 2002), harmony (Satoh et al., 2001; Sridharan et al., 2007), and timbre (Platel et al., 1997). Refer to Table 1.

Table 1
Brain Areas Active during Attention or Musical Tasks

Non-Musical Stimuli	Musical Stimuli	Common Brain Regions
Parieto-temporo-occipital area (selective)	Right auditory cortex Right anterior part of Heschl's gyrus Posterior secondary cortex (pitch)	Bilateral Frontal Lobe
Midbrain reticular activating system	Inferior frontal areas (frontal operculum) bilaterally (harmony).	Bilateral Prefrontal Lobe
Limbic structures (sustained)	Right anterior superior temporal gyrus (meter)	Right Superior Temporal Gyrus
Frontal lobes	Left temporal lobe	Basal ganglia
Anterior cingulate gyrus	Basal ganglia (rhythm)	Bilateral Superior Parietal Lobe
Basal ganglia	Right auditory cortex	Right Inferior Parietal Lobe
Thalamus (switching)	Frontal cortical areas: dorsolateral and inferior frontal areas (WM pitch)	
Right hemisphere (sustained)	Left inferior temporal and frontal areas (WM melody)	
Left hemisphere (selective)	Motor cortex Cerebellum Corpus callosum Basal ganglia (performing)	
	Limbic and paralimbic areas, Amygdala Hippocampus Cingulated cortex Orbitofrontal cortex (emotions elicited from music)	

Adapted from Peretz & Zatorre, 2005; Zatorre et al., 2007; Sarkamo et al., 2013; Ponsford, 2008, Cognitive Neurorehabilitation, in Stuss, D.T., Winocur, G. & Robertson, I.H. (Eds.), Chapter 29, p.508.

Attention operates in sensory-specific modalities. These networks involved in orienting appear to overlap (Peterson & Posner, 2012). There are studies of the neuroanatomy of attention that reveal that attentional capacities are supported by a complex neurological system that receives support from the brain stem, frontal lobes, limbic system, temporal lobes, and parietal lobes. Because of this, rehabilitation efforts need to be directed towards many areas of the brain and has to be multimodal (Mirsky et al., 1991). The attention system is one that can be modified with targeted intervention (Mateer 2000; Cicerone et al. 2000; Rimmele and Hester 1987; Sohlberg and Mateer 1987). This may suggest that multi-modal intervention, such as music, could be effective in strengthening attention skills. This overlap of orienting networks may also support the transfer of benefit from one sensory modality to another.

Music and Attention in ASD

Several studies have found that music engages children with ASD, and when applied in a systematic manner, may improve attention control skills (Carnahan, Musti-Rao, & Bailey, 2009; Finnigan & Starr, 2010; Kim, Wigram, & Gold, 2009). Individuals with ASD have difficulty with sustained, selective, and attentional control/ switching attention (Sanders, Johnson, Garavan, Gill, & Gallagher, 2008; Ravizza et al., 2013). Attention-related skills like initiating, inhibiting, or otherwise controlling responses are difficult for those with ASD (Schopler, Van Bourgondien, Wellman, & Love, 2010). During music therapy, individuals with ASD were actively engaged and complied with interpersonal demands (Kim, Wigram, & Gold, 2009). Children with ASD also were found to improve their joint-attention skills when participating in music-based experiences (Kalas, 2012; Kim et al, 2009; Reitman, 2006). Joint attention is the ability to attend to cues from one individual and direct their attention from the individual to the object the individual is referencing. Wigram and Gold (2006) stated that the increased attention

skills during music might be due to the structure and predictability inherent in active music making. Research findings provide support that music facilitates attentional control and interventions specifically targeting attention skills may provide motivation and structure for improvement of engagement, disengagement, and switching attention. Gardiner and Horwitz (2015) saw improvements in attention skills and concluded that comprehensive approaches to rehabilitation and strategies targeting specific cognitive skills such attention have helped improve mental abilities. The findings were also consistent with NMT studies demonstrating that attention (Robb, 2003) can be improved with musical exercises. It has been found that music therapy treatment improved attention skills in individuals with traumatic brain injury (Thaut et al., 2009; Mueller, 2013).

Music Attention Control Training (MACT)

Due to music's effect on the brain and its ability to improve capacities for attention (Morton et al., 1990), Music Attention Control Training (MACT) was a technique proposed by Thaut (2005) to address attention skills. MACT includes structure active or receptive musical exercises involving precomposed performance or improvisation in which musical elements cue different musical responses to practice types of attention which include selective, sustained, and attentional control/switching functions. For selective attention, MACT assists clients in maintaining focus while being bombarded with competing stimuli. For alternating attention, therapists can have clients shift focus among various stimuli at command similar to other attention training techniques. For sustained attention, therapists can have clients engage in creating and sustaining rhythmic patterns to address this aspect of attention (Thaut, 2005).

Pasiali, Lagasse, and Penn's (2014) pilot study found that the MACT protocol and testing measures were feasible to implement and acceptable to the nine participants. The data analyses

indicated that more research on the use of music therapy attention training in high-functioning adolescents with neurodevelopmental disabilities is warranted. Abrahams and Dooren (2017) conducted a randomized controlled pilot study on the effects of MACT protocol on six residential youth diagnosed with attention-related issues. The results showed that both the intervention and the means of measurement were feasible in this population and demonstrated positive trends in attention skills where more extensive research is necessary to further evaluate the effects.

Purpose of the Study and Research Questions

Although evidence supports the use of music for attentional skills in persons with disabilities, there is only a single pilot study investigating the use of a music therapy attention protocol on the sustained, selective, and attentional control/switching attention in children or pre-adolescents with ASD. The aims for this modified replication study were to: (a) investigate the effectiveness of the Music Attention Control Training (MACT) protocol on different types of attention (sustained, selective, attentional control/switching) behavior in pre-adolescents with Autism Spectrum Disorder and (b) to identify the impact of severity of autism on changes in attention scores.

The following research questions will be addressed:

1. Are there any changes in attention skills (sustained, selective, alternating) between pre- and post-treatment measures?
2. Is there any identifiable impact of severity of autism on changes in attention scores?

CHAPTER 3: METHOD

Participants and Settings

Participants were recruited from a local school district in the Central Valley of California with special classrooms for pre-adolescents with ASD who require various levels of support. The autism specialist from the school district identified two middle schools with two classrooms each that met the inclusion criteria (age 10-14 years with ASD). The principal investigator asked the teachers of the respective classes to contact the student's families/guardians to obtain informed consent. Principle investigator, upon consent, assessed the participants for their severity level using the High Functioning Version of the Childhood Autism Rating Scale (CARS2-HF; Schopler et al., 2010). The principal investigator and the teachers worked directly with the students to complete CARS2-HF. The team sought parental feedback when clarification was needed.

Research Design

A randomized clinical trial study design was adopted to investigate the effects of MACT on attention skills (sustained, selective, switching) with pre-adolescents with ASD. Two classes of students in each school were stratified by severity level (mild, moderate, and severe) and randomly assigned to a waitlist control or a treatment group. Their severity rating was measured by the (CARS2-HF) completed by the principal investigator before the implementation of the treatment. Their attention skills were assessed with the Test of Everyday Attention for Children 2 (TEA-Ch 2) before treatment and after treatment. See Figures 1 and 2 for diagram of research design of each school.

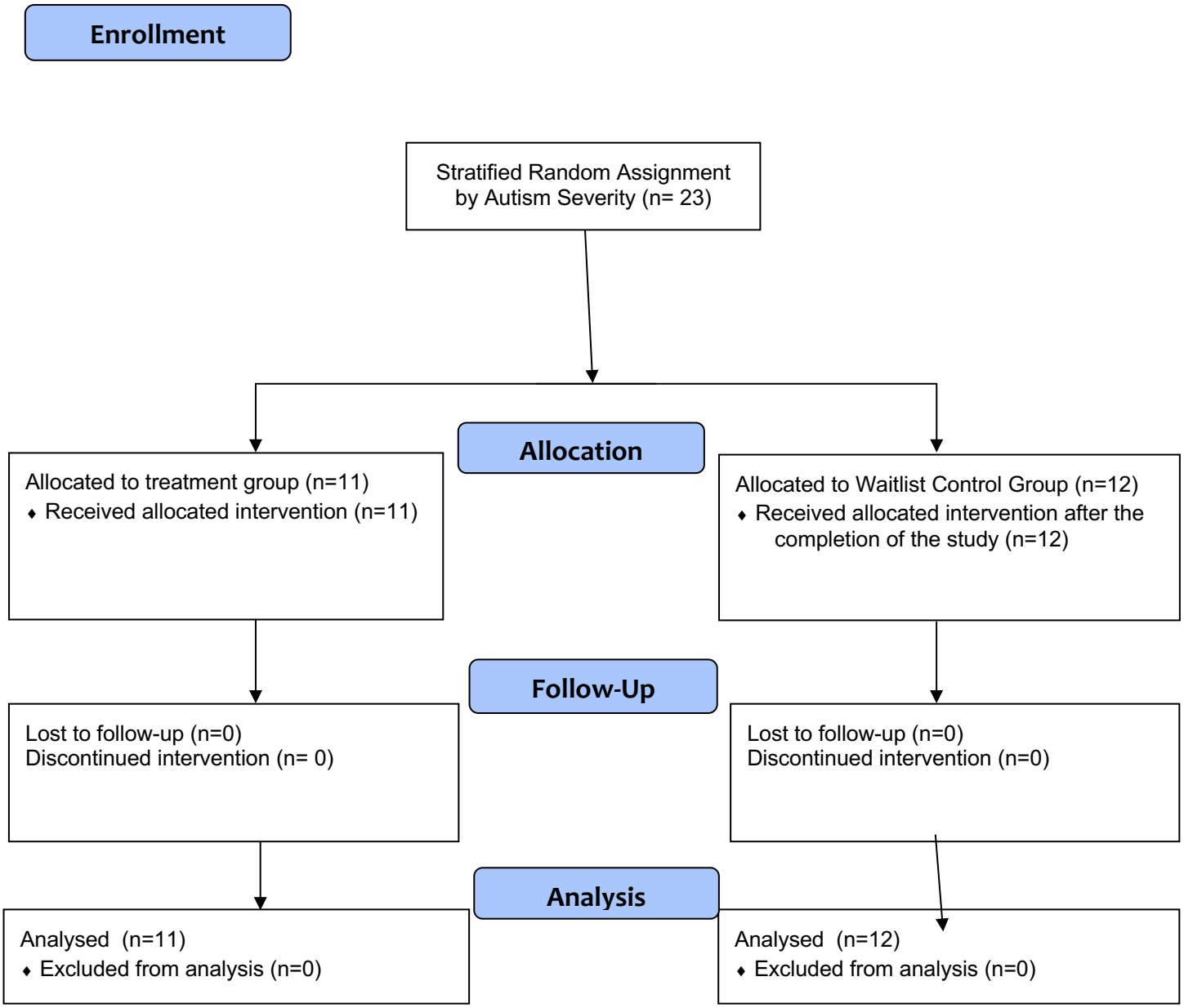

Figure 1. Research Design Diagram

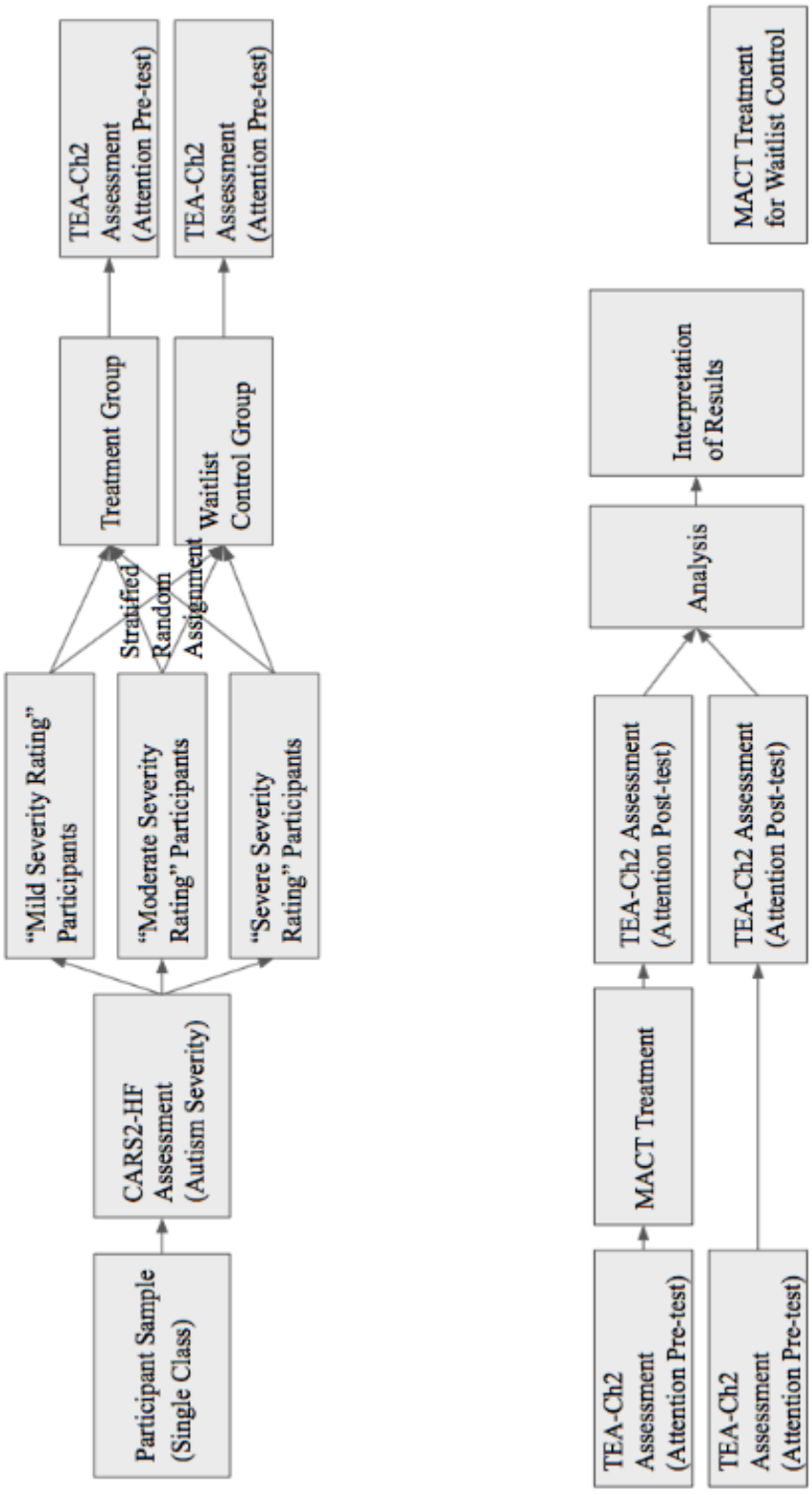

Figure 2. Detailed Design Flow Chart

Procedure

The principal investigator administered the two parallel versions of the TEA-Ch2 pre- and post- tests to assess attention. Testing was conducted in a quiet office at the participants' school. The researcher recorded scores on scoring sheets and on a password-protected computer. After the completion of the pre-test, the researcher implemented a six week, 45-minute treatment protocol using the NMT technique: MACT. The researcher recorded observation notes on a password protected computer and were deleted after the completion of the study.

Measures

CARS2-HF

The High Functioning Version of the Childhood Autism Rating Scale, developed by Schopler et al. (2010), includes ratings of 15 functional areas including social-emotional understanding/regulation, interpersonal skills, use of body, play/interests, anxiety, response to visual and auditory stimuli, receptive/expressive communication, and cognitive skills. Clinicians can use the scale to identify children with autism and determine symptom severity. Ratings are based on direct observations of the intensity and duration of specific behaviors. The high functioning version was developed for individuals 6 years of age and older with IQ scores above 80. The internal consistency of CARS2-HF is estimated as .96. Interrater reliability is .95. The total raw scores of CARS2-HF range from 15-60. Raw scores lead to a diagnostic hypothesis of autism-related symptoms as follows: 15-27.5 minimal or no autistic behaviors, 28-33.5 mild-to-moderate level of autistic behaviors, 34-60 severe autistic behaviors.

TEA-Ch2

The TEACH-2 is a measuring tool that includes eight tasks that require different types of skills such as sustained, selective, and attentional control/switching attention. The TEA-Ch2 provides scaled scores and index scores as the two main forms of test scores. At the subtest level, there are a scaled score and percentile rank as well as composite scores and percentile ranks for three indexes: Sustained Attention Index, Selective Attention Index, and Everyday Attention Index. The estimated length of time required to complete TEA-Ch2 is 35- 55 minutes. The tool has two versions to allow for test-retest. The test-retest reliability coefficients for the subtests range from lower (>.4) to good (>.8) with most subtests being acceptable. The TEA-Ch2 has strong validity in criterion validity, concurrent validity, and construct validity. Table 2 provides an overview of the subtests for each attention skill.

Table 2
TEA-Ch2 Subtests

Selective Attention	**Sustained Attention**	**Switching Attention**
Hector Cancellation	Vigil	Reds & Blues, Bags & Shoes
Hector-B Cancellation	SART	
Hecuba Visual Search	Simple RT	
Troy Dual Task	Cerberus	

The four scoring items for **sustained attention skills** are Vigil, SART, Simple RT, and Cerberus.

- Vigil is a measure of an examinee's ability to maintain their attention on a slow, dull task. In each trial there is an opening, ascending sound, indicating that the trial has begun, then a series of repeated (dog barks) that are to be counted, and then a closing, descending sound, indicating that the trial is complete. Due to the long gaps between the sounds that the examinee has to count, the task does not 'grab' the examinee's attention. This addresses the examinee's ability to self-sustain their attention.

- SART is the Sustained Attention Response Test. This is a test of the examinee's ability to maintain an attentive stance to a task and not allow their responses to be 'driven' in an absentminded fashion by the task. In the SART, a set of shapes is presented sequentially in the center of the monitor. The shapes are presented at a regular pace that is independent of the examinee's response. The examinee's task is to respond to each of the shapes by hitting a response key in time with an on-screen cue but to withhold the response to one of the shapes.

- Simple RT is the Simple Reaction Time subtest. The aim of this test is to obtain a reliable estimate of simple reaction time by measuring responses to the onset of a visual target. As soon as they see a blue blob appear on the screen, they must press the spacebar.

- Cerberus is an auditory target-detection task in which the examinee is asked to listen to short sound clips and press the spacebar as quickly as possible if a bark occurs. Distractor sounds can also be heard, but examinees are required to ignore these sounds. The examinee will be asked to listen carefully to each sound clip in which sometimes a dog bark will be heard, and sometimes not. Distractor sounds in the form of other animal noises will also be heard, but the examinee is told to ignore these.

The three scoring items for **selective attention skills** are: Hector Cancellation, Troy Dual Task, and Hecuba Visual Search.

- Hector Cancellation is a subtest that examines how many targets an examinee can find and mark within a series of 10-second trials. There are three levels of difficulty, repeated in counterbalanced order, in which the density of distractors is varied.

- Troy Dual Task is a subtest that examines slowing in a Hector Cancellation-like task, resulting from simultaneous performance of a Vigil-like auditory counting task. A series of to-be-counted sounds is played as the examinee marks given targets. On each trial, the cymbal crash at the end of a countdown drum sequence indicates when the examinee should start canceling yellow lozenge targets (as in Hector Cancellation task). The next cymbal crash indicates when the examinee must stop canceling targets and report how many sounds were presented (as in Vigil task).

- Hecuba Visual Search is a visual search task that does not require a motor response. The examinee is asked to inspect a series of panels and report whether a target is present or absent. This provides a measure of an examinee's ability to detect a visual target amongst distractors, within a limited time.

The one scoring item for attentional control/switching attention skills is Red & Blues, Bags & Shoes.

- Red & Blues, Bags & Shoes is a test of mental flexibility that addresses the cost of switching between two relatively simple tasks. Examinees are asked to practice sorting

four repeating stimuli according to color (red one side of the screen, blue on the other) and to whether they are held in the hand or worn on the foot.

Group Music Therapy Intervention

Using intervention reporting guidelines (Robb, Carpenter, & Burns, 2010), the following protocol may be used to address attention skills in populations with ASD in a strategic and standardized way.

Intervention Theory

Due to overlapping areas of the brain for attention and music, there has been research that shows that attention skills can be increased using music. The technique used to increase attentional skills is MACT (Thaut, 2005). Pasiali, Lagasse, and Penn's (2014) pilot study found positive trends in attention training using MACT with high-functioning adolescents with neurodevelopmental disabilities. Abrahams and Dooren (2017) also conducted a randomized controlled pilot study on the effects of MACT protocol on residential youth diagnosed with attention-related issues. The results showed positive trends in attention.

MACT includes structured active or receptive musical exercises involving precomposed performance or improvisation in which musical elements (pitch, rhythm, dynamics, etc.) cue different musical responses to address attention skills (selective, sustained, and alternating functions). For selective attention, MACT give opportunities for the subjects to maintain focus while ignoring competing stimuli. For alternating attention, subjects have to shift focus among various stimuli. For sustained attention, the subjects are actively engaged in creating and sustaining rhythmic patterns (Thaut, 2005).

Intervention Content

This intervention strategy (MACT) employs music elements to increase attention skills. The intervention will be delivered at sites where the group of clients are centrally located,

possibly in schools or other facilities. The sessions will take place in a separate room where privacy will be established and where distractions would be minimal with little ambient. Intervention materials can consist of rhythm sticks, drums, glockenspiels, pre-recorded music, frame drums, etc. (chosen by the interventionist). A group of subjects will receive treatment by participating in six, 45-minute group sessions over a period of six weeks. The interventions are all referenced or influenced by Thaut & Hömberg (2016) and Thaut (2008) books and interventions shown at the NMT workshop. The interventionalist used age-appropriate and/or preferred client music to maintain active engagement and focus. See Appendix A for interventions and session plans.

Some examples of what this might look like would be to address sustained attention, adapted Orff-based musical tasks were used (e.g., the subject could play the xylophones while closely following the colored signs). For alternating attention, structured drumming/rhythm experiences were provided (e.g., the subject could play on one drum when they hear a bell and the other drum when they hear a). For selective attention, structured/unstructured improvisation was implemented (the subject would improvise freely on the drums and then when they hear a certain rhythm from another instrument, they would be alerted to play a pre-assigned rhythmic pattern).

The interventionist is a Board-Certified Music Therapist with extensive experience working with ASD populations. A single interventionist can administer the MACT treatment to a group of subjects. The interventions were delivered to groups of individuals of 5 or 6 students. Strategies that will be used to encourage fidelity of treatment delivery consisted of having a board-certified neurologic music therapist using interventions and interventions referencing the MACT protocol (Thaut, 2005)

Analysis

Research Question #1

Means and SD's of the individual subtests and indexes for attention skills (sustained, selective, alternating) were calculated for the TEA-Ch2 data before and after the intervention. This was followed by two-tailed paired-sample *t*-tests comparing pre- and post- treatment scores for both control and treatment groups. The alpha level was .004 (.05/12) with Bonferroni adjustment for multiple t-tests. Effect sizes were calculated for clinical significance.

Research Question #2

Means and SD's of each severity level (mild, moderate, severe) were calculated for the TEA-Ch2 data before and after the intervention. A two-way ANOVA were conducted for pre- and post- treatment with severity as between subjects factors.

CHAPTER 4: RESULTS

Participants

The participants were recruited from two middle schools with special classrooms for pre-adolescents with ASD who require support. Twenty-three students were eligible to participate in the study with the average age of 12.13 years (*SD* = 1.08), ranging from 10 to 14 years. There were 16 boys and 7 girls (*N = 23)*. Students from one classroom from each school were randomly assigned to the treatment and waitlist-control groups. In the first classroom, treatment group had 4 boys and 2 girls (4- Severe, 1- Moderate, 1- Mild) and the control group had 4 boys and 2 girls (3- Severe, 1- Moderate, 2- Mild). In the second school, the treatment group had 4 boys and 1 girl (4- Severe, 1- Moderate) and the control group had 4 boys and 2 girls (4- Severe, 1- Moderate, 1- Mild**).** The parents of all eligible students consented to participating in the study and all the students verbally assented to complete the testing and participate in the sessions.

Participation Rate

All music therapy sessions occurred during regular school hours. Student participants perceived participation in music therapy as part of their daily class schedule. The recruited participants (*n* = 23) participated in the study and attended music therapy sessions. There were no withdrawals from the study. One participant missed the two sessions due to behaviors. Another participant missed one session due to illness. There were no further absences. During music therapy, all students in attendance frequently participated fully without refusing to engage.

Evaluation

All 23 participants completed both pre and post-testing as scheduled. Overall, all participants completed the TEA-Ch2 during the standard time reported by those who created the

measure. Students who could not complete certain subtests, discontinued that particular subtest and continued on to the next subtest as directed by the assessment manual. There is a selective, sustained, and an everyday attention (switching/alternating) index given when all of the subtests within one domain is completed. There is not a final index score for a domain when there are too few trials that were successful, suboptimal number of trials, or the subtest is discontinued within a certain index.

Potential Barriers

The study was completed in three months. All pretesting was completed within three weeks prior to beginning music therapy sessions. The music therapy sessions spanned a period of 6 weeks for once a week. Post-testing was completed within 2 weeks following completion of the music therapy sessions. Since this study was completed at a school, breaks and holidays were observed with the school calendar. Planned events impacting implementation of this study included: one-week spring break during the treatment period. Students demonstrated some regression of attention skills after their scheduled school break and this should be considered as this may impact in the interpretation of the results.

Statistical Outcomes

Research Question #1

Means and SDs of the individual subtests for attention skills (sustained, selective, alternating) were calculated for the TEA-Ch2 data before and after the intervention. The results showed positive directional changes on subtests related to selective attention and attentional control/switching (see Table 2). Significant results via two-tailed paired-sample *t*-test using an alpha level of .10. Statistical analysis confirmed significant positive trends with the treatment

group for the 3 out of 4 subtests of selective attention: Hector Cancellation, Hector-B Cancellation, and Hecuba Visual Search; 1 out of 4 subtests of sustained attention: SART; and the single subtest of alternating attention: RBBS. No significant results except for the control group in the sustained attention subtest: SART.

Table 3
Descriptive Statistics and Paired-Samples T-tests Comparing Subtests Means over Time, Separately by Condition

	Pre-	Post-	df	*t*	*p*	σ^2
Selective						
Hector Cancellation						
Control	4.67 (5.57)	4.58 (3.20)	11	-.065	.949	19.722
Treatment	3.36 (2.29)	5.27 (3.77)	10	3.601	.005***	3.091
Hector-B Cancellation						
Control	5.83 (3.59)	6.00 (3.30)	11	.226	.825	6.513
Treatment	3.82 (1.94)	7.36 (2.50)	10	5.221	.000***	5.072
Hecuba Visual Search						
Control	4.09 (2.74)	5.36 (2.77)	10	1.228	.248	11.820
Treatment	4.64 (2.73)	6.64 (2.38)	10	7.416	.000***	.799
Troy Dual Task						
Control	1.80 (1.10)	2.40 (2.61)	4	.688	.529	3.799
Treatment	3.50 (2.39)	2.25 (2.77)	7	-1.279	.242	7.645
Sustained						
Vigil						
Control	6.33 (4.97)	7.33 (4.76)	5	.447	.673	29.998
Treatment	8.00 (3.51)	8.00 (2.65)	6	.000	1.000	10.336
SART						
Control	3.70 (2.83)	5.40 (4.25)	9	2.014	.075***	7.124
Treatment	4.20 (3.65)	7.40 (4.90)	9	1.986	.078***	25.960
Simple RT						
Control	4.78 (3.80)	3.33 (2.06)	8	-1.64	.141	7.027
Treatment	5.40 (4.65)	5.00 (3.78)	9	-.647	.534	3.822
Cerberus						
Control	8.60 (3.36)	13.00 (3.81)	4	1.611	.182	37.230
Treatment	10.67 (6.77)	9.17 (2.93)	5	-.57	.590	40.704
Switching (Attentional Control)						
RBBS						
Control	6.83 (2.71)	4.17 (2.48)	5	-1.86	.121	12.264
Treatment	7.75 (4.53)	4.38 (3.20)	7	-3.903	.006***	5.983
Selective Attention Index						

Control	66.75 (17.35)	65.75 (9.91)	3	-1.60	.883	156.675
Treatment	61.63 (9.74)	70.63 (11.50)	7	3.941	.006***	41.719
Sustained Attention Index						
Control	70.67 (10.26)	76.67 (17.62)	2	.373	.745	777.016
Treatment	83.60 (19.62)	88.00 (14.98)	4	1.021	.365	92.795
Everyday Attention Index (All Subtests) (Table #2 Continued)						
Control	52.00 (5.20)	58.00 (13.08)	2	.62	.597	278.990
Treatment	69.60 (11.01)	73.80 (8.93)	4	.96	.394	96.708

Notes. * Significant at *p< .10, **p<.05, *** p<.01. Higher scores represent higher scaled scores for the following sub-tests of the TEA-Ch2: Hector Cancellation, Hector-B Cancellation, Hecuba Visual Search, Troy Dual Task, Vigil, Sustained Attention to Response Test (SART). Lower scores represent higher scaled scores for the following sub-tests of the TEA-Ch2: Simple Reaction Time (Simple RT), Cerberus, Red & Blues, Bags & Shoes (RBBS).

Analysis of Individual Subtests

Hector Cancellation subtest is an indicator of selective attention. There was a statistically significant difference between the two groups, treatment group (M = 5.27, SD = 3.77, p = .005 and the control group (M = 4.58, SD = 3.20), $t(df)$ = -.065(11), p = .949. We are 90% confident that for those in the treatment group, Hector scaled scores increased at least .948 and at most 2.870 points. The treatment demonstrated a statistically significant positive change for this subtest.

Hector-B Cancellation subtest is an indicator of selective attention. There was a statistically significant difference between the two groups, treatment group (M = 7.36, SD = 2.50) $t(df)$ = 5.221(10), p = .000 and the control group (M = 6.00, SD = 3.30), $t(df)$ = .226(11), p = .825. We are 90% confident that for those in the treatment group, Hector B scaled scores increased at least 2.315 and at most 2.870 points. The treatment demonstrated a statistically significant positive change for this subtest.

Hecuba Visual Search subtest is an indicator of selective attention. There was a statistically significant difference between the two groups, treatment group (M = 6.64, SD = 2.38) $t(df)$ = 7.416(10), p = .000 and the control group (M = 5.36, SD = 2.77), $t(df)$ = 1.228 (10), p = .248. We are 90% confident that for those in the treatment group, Hecuba scaled scores increased at least 1.511 and at most 2.489 points. The treatment demonstrated a statistically significant positive change for this subtest.

Troy Dual Task subtest is an indicator of selective attention. There was not a statistically significant difference between the two groups, treatment group (M = 2.25, SD = 2.77) $t(df)$ = -1.279 (7), p = .242 and the control group (M = 2.40, SD = 2.61), $t(df)$ = .688(4), p = .529. We are 90% confident that for those in the treatment group, Troy scaled scores increased at least -3.102 and at most .602 points. The treatment did not demonstrate a statistically significant change for this subtest. The results of this subtest could have been attributed to the inconsistent administration of the post-test. Due to the directions of the post-test being different than the pre-test this could have confused and misled the students.

Vigil subtest is an indicator of sustained attention. There was not a statistically significant difference between the two groups, treatment group (M = 2.25, SD= 2.77) $t(df)$ = -1.279 (7), p= .242 and the control group (M = 2.40, SD = 2.61), $t(df)$= .688(4), p = .529. We are 90% confident that for those in the treatment group, Vigil scaled scores increased at least -2.361 and at most 2.361 points. The treatment did not demonstrate a statistically significant change for this subtest.

SART subtest is an indicator of sustained attention. There was a statistically significant difference between the two groups, treatment group (M = 7.40, SD =4.90) $t(df)$ = 1.986 (9), p= .075 and the control group (M = 5.40, SD = 4.25), $t(df)$= 2.014 (9), p = .078. We are 90%

confident that for those in the treatment group, SART scaled scores increased at least .237 and at most 6.153 points. The treatment demonstrated a statistically significant change for this subtest. Based on the two individual confidence intervals it appears that even without the treatment on SART there seems to be a significant improvement. However, it looks like for the treatment the growth may exceed the expected growth of the control. We were unable to test directly with a group x time interaction within a 2-way ANOVA due to limited statistical power as a function of small sample sizes.

SIMPRT subtest is an indicator of sustained attention. There was not a statistically significant difference between the two groups, treatment group (M = 5.00, SD = 3.78) *t(df)*= -.647 (9), p = .534 and the control group (M = 3.33, SD = 2.06), *t(df)*= -1.64 (8), p = .141. Lower scores mean an improvement in sustained attention. We are 90% confident that for those in the treatment group, SIMPRT scaled scores decreased at least -1.53 and at most .733 points. The treatment did not demonstrate a statistically significant change for this subtest. Although there is a decrease for both groups, and a more pronounced decrease for the control group, it was still not statistically significant.

Cerberus subtest is an indicator of sustained attention. There was not a statistically significant difference between the two groups, treatment group (M = 9.17, SD = 2.93) *t(df* = -.57 (5), p = .590 and the control group (M = 13.00, SD = 3.81), *t(df)*= 1.611(4), p= .182. Lower scores mean an improvement in sustained attention. We are 90% confident that for those in the treatment group, Cerberus scaled scores decreased at least -6.748 and at most 3.748 points. The treatment did not demonstrate a statistically significant change for this subtest. However, the treatment showed positive trends in improving sustained attention compared to negative trends with the control group.

Red & Blues, Bags & Shoes subtest is an indicator of alternating/switching attention. There was a statistically significant difference between the two groups, treatment group (*M* = 4.38, *SD* = 3.20) *t(df)* = -3.903(7), *p* = .006 and the control group (*M* = 4.17, *SD* = 2.48), *t(df)* = -1.86 (5), *p* = .121. Lower scores mean an improvement in switching/alternating attention. We are 90% confident that for those in the treatment group, RBBS scaled scores decreased at least -6.748 and at most 3.748 points. The treatment demonstrated a positive statistically significant change for this subtest.

Selective Attention Index is comprised of Hector, Hector B, Hecuba, and Troy subtests. There was a statistically significant difference between the two groups, treatment group (*M* = 70.63, *SD* = 11.50) *t(df)* = 3.941(7), *p* = .006 and the control group (*M* = 65.75, *SD* = 9.91), *t(df)* = -1.60 (3), *p* = .883. We are 90% confident that for those in the treatment group, Selective Attention Index scaled scores increased at least 4.674 and at most 13.326 points. The treatment demonstrated a positive statistically significant change for the selective attention domain.

Sustained Attention Index is comprised of Vigil, SART, SimpleRT, and Cerberus subtests. There was not a statistically significant difference between the two groups, treatment group (*M* = 88.00, *SD* = 14.98) *t(df)* = 1.021(4), p= .365 and the control group (*M* = 76.67, *SD* = 17.62), *t(df)* = .373(2), *p* = .745. We are 90% confident that for those in the treatment group, Sustained Attention Index scaled scores increased at least -4.784 and at most 13.584 points. The treatment did not demonstrate a statistically significant change for the sustained attention domain. Everyday (Switching/Alternating) Attention Index is comprised of the Red & Blues, Bags & Shoes subtest. There was not a statistically significant difference between the two groups, treatment group (*M* = 73.80, *SD* = 8.93) *t(df)* = .96(4), *p*= .394 and the control group (*M* = 58.00, *SD* = 13.08), *t(df)* = .62(2), *p* = .597. We are 90% confident that for those in the

treatment group, Sustained Attention Index scaled scores increased at least -5.175 and at most 13.575 points. The treatment did not demonstrate a statistically significant change for the switching/alternating attention domain.

Research Question #2

The second research question examined possible impact of severity of autism on changes in attention scores. This research question could not be addressed due to the low power of the number of participants in the mild and moderate severity group. There are not enough participants in each severity level of ASD to make conclusions about the moderating effect for the effectiveness of MACT on attention skills.

CHAPTER 5: DISCUSSION

Children with ASD often are distracted by irrelevant stimuli and have difficulty with switching between sources of stimuli. The ability to control attention impacts cognitive functioning and learning, interventions that improve attention function could positively impact daily living and academic success.

The purpose of this study is to determine the effect of the MACT protocol on sustained, selective, attentional control/switching attention behavior in pre-adolescents (10-14 years old) with ASD. The studied sought to investigate the changes in attention skills and to identify the impact of severity (mild, moderate, severe) on changes in attention scores. The study replicated a pilot study and investigated the effectiveness of the MACT intervention on attention behavior in pre-adolescents with ASD.

The original pilot study had a single group of 9 subjects, three of which had severe symptoms, four had mild to moderate symptoms, and two participants had minimal to no symptoms of ASD according to CARS2-HF. This study had 23 subjects total (*N=23)* between classrooms. Each classroom was split into two groups, one treatment and one control with a total of four groups. The treatment and control groups had 5-6 subjects each and had an equivalent composition of subjects with severe, moderate, and mild ASD symptoms.

Research Question #1

Selective Attention

The results confirmed significant positive trends with the treatment group for the measures of selective attention index and selective subtests: Hector Cancellation, Hector-B

Cancellation, and Hecuba Visual Search; Sustained subtests: SART. This suggests that the MACT intervention could be effective in improving selective attention.

Sustained Attention

There was no significant difference for measures of sustained attention index (Table 1). Although there were significant findings for 1 out of the 4 subtests for sustained attention, it was not enough to find significant findings for the sustained attention index. Little significance found in the sustained attention tests could be explained through research that indicates individuals with ASD do not have sustained attention deficits (Sanders et al., 2008). In the pilot study, measures related to sustained attention had no observable changes in direction for any subtests. In this current study, there were improvements in one out of the four sustained attention subtests.

Switching Attention

The results confirmed significant positive trends with the treatment group for the measures of the alternating subtest: RBBS. This suggests that the MACT intervention could be effective in improving switching attention. This differed from the original pilot study because there was no significance found with switching attention (Pasiali et. al, 2014).

Research Question #2

The second research outcome question was focused on identifying the impact of autism severity on changes in attention scores. A conclusion could not be established about the severity of ASD affecting the effectiveness of the treatment. There were no observable patterns for children who were considered “mild” by the CARS2-HF (28–33.5) or severe (above a score of 34). This could not be concluded due to the lack of power at each severity level. In the future, it would be more informative if the CARS2-HF were given first to the students and have three

separate treatment groups for the three severity levels. This design would allow for more observable patterns at the different severity levels.

Limitations and Recommendations

The following limitations should be considered when interpreting the results of the present investigation: a) the small sample size causing low power, b) research bias in administration of testing measures (specifically subtest Troy Dual Task), c) history effect (maybe something else happens) due to the length of time for individual pre-testing, and d) holidays causing history effect and the regression of skills. A larger sample size would increase the amount of participants who would be able to fully complete each subtest and would yield more robust, meaningful findings. There were some complications with administration of the measures. The school psychologists should be trained adequately to accurately administer the assessment measures. In the Troy Dual Task, the control group indicated more positive change than the treatment group. The results of this subtest could have been attributed to the inconsistent administration of the post-test. Due to the inconsistent directions given by the administrator of the post-test the results might not be a true reflection of their skills in this particular subtest. Regarding the maturation effect, the number of students for one administrator to assess proved difficult to pre- and post- test all of them within a reasonable time frame. In the future, incorporating more trained administrators to conduct the pre- and post- test would increase the speed at which the attention assessments were completed to minimize time spent from the first to the last assessment. It also proved difficult to find consecutive weeks within the school year that did not have special events, school holidays, or teacher days. To address the regression of skills in the students, common after returning from a break, the issue was brought to the teachers. The teachers adapted by being flexible with the time and day of the week the treatment was

administered. It is recommended to avoid implementation of the procedure with a break in the school schedule.

Further investigations could include extending the implementation of the treatment to more than 6-8 weeks to improve retention of the skills learned in switching and sustained attention. The MACT protocol should continue to be tested in small groups of 4-6 students for more individualized attention. It's recommended to increase the sample size for future replication studies. It is recommended to double-blind the administrators to control for biased assessment and implementation of treatment. It's recommended to find another measure that would provide more descriptive results. The measure needs to be adapted to the functioning level of the individuals with ASD and will be able to discriminate between level of attention skills. Future research on this protocol should strive to address these limitations in order to better test efficacy of the MACT intervention with pre-adolescents who have ASD.

Summary and Conclusions

In summary, outcomes from this study indicate that the MACT intervention is statistically significant in addressing selective attention skills in pre-adolescents with ASD. There were no conclusions made about the effect of the severity level of ASD symptoms on the effectiveness of the treatment due to low sample size. This data supports the pursuit of an even larger controlled trial to the test efficacy of the MACT intervention for pre-adolescents with ASD.

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APPENDIX A: PARENTAL CONSENT FORM

Parental Consent Form

The Effect of Musical Attention Control Training (MACT) on Attention Skills of Pre-adolescents with Neurodevelopmental Delays

Dear Parent or Guardian,

Your child is invited to participate in a research study being conducted at _____ School. The study investigates the attention skills of children 11-14 diagnosed with mild- moderate Autism Spectrum Disorder (ASD).

My name is Vienna Sa, MT-BC and I am a Board-Certified Music Therapist and Music Therapy Graduate Student at the University of the Pacific. Your child was selected to participate in this study because of their age group and diagnosis.

The purpose of this research is to investigate if the music therapy technique, Music Attention Control Training (MACT), can improve the attention skills of a child with mild-moderate ASD. If you decide to allow your child to participate, they will be asked to participate in a 45-minute music therapy session once a week for a period of 6 weeks. Some activities might look like playing the xylophones when directed or playing drumming rhythms within a group setting. Assessment results, notes, and audio recordings will be collected on your child. I will listen to the recordings to look at the length of your child's attention and the quality of their music playing.

The risks to your child while participating in this study are minimal as might be experienced in the course of a regular school day in the classrooms. These risks may include frustration or discomfort with new experiences using musical instruments. We will carefully monitor your child to assist them so as to limit or stop any activity that would cause them discomfort. If your child does not want to participate on any given day, they can choose to not participate with no penalty or loss of benefits. All information from this study will remain confidential. Data collected will remove identifying information. Written data will be kept in a locked file cabinet on the campus of the University of the Pacific. Audio recordings will be destroyed at the end of this study and written data will be shredded. Results may be presented in a

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class or professional presentation with no identifying information on your child. If interested, at the end of the study, you may have the choice to see the effect of MACT on the attention skills of your child before and after the study.

The principle investigator is a mandated reporter and is legally required to report any suspicion of child abuse or neglect to the relevant authorities. If you have any questions or concerns about the research at any time, please email me at v_sa@u.pacific.edu or call me at 518-428-8658. If unable to reach me, please email the faculty that will advising this research, Dr. Hsiao at fhsiao@pacific.edu. Your child's participation in this study is entirely voluntary. Your decision whether or not they will participate will involve no penalty or loss of benefits to your child. If you decide to allow your child to participate, you are free to stop at any time without penalty to your child.

If you have any questions about your rights as a participant in a research project please contact the Office of Research and Sponsored Programs, University of the Pacific (209) 946- 3903. In the event of a research-related injury, please contact your regular medical provider and bill through your normal insurance carrier, then contact the Office of Research and Sponsored Programs.

Your signature below indicates that you have read and understand the information provided above, that you have been afforded the opportunity to ask, and have answered, any questions that you may have, that your and your child's participation is completely voluntary, that you understand that you or your child may withdraw consent and discontinue participation at any time without penalty or loss of benefits to which you or your child are otherwise entitled, that you will receive a copy of this form, and that you are not waiving any legal claims, rights or remedies.

Institutional Review Board FWA00004103
APPROVED
Expiration: 2/28/20
IRB#: 19-05
UNIVERSITY OF THE PACIFIC

Child's Name: _____

Parent/Legal guardian Signature: _____ **Date:** _____

APPENDIX B: VERBAL RECRUITMNET SCRIPT

Verbal Recruitment Script

The Autism Specialist will suggest certain classrooms with the ideal age and population for the research study. The Autism Specialist will notify the selected classroom teachers that the lead researcher will be visiting the classroom to speak about the study and how the topic might benefit their students. The following sample verbal recruitment script will be used:

"Thank you for finding the time to meet with me. I'm Vienna Sa and a Master's student at the University of the Pacific's Music Therapy Program. My thesis looks at the effect of Musical Attention Control Training (MACT) on attention skills of pre-adolescents with Neurodevelopmental Delays. I'm looking for participants diagnosed with Autism Spectrum Disorder and are between the age ranges of 11-14 years old. The MACT protocol is typically used to improve different types of attention. If your students and their parents consent to participate in the study, they will be attending 45-minute music therapy sessions once a week for a period of 6 weeks. The music therapy session will include the use of MACT and involve various musical activities designed to address different types of attention. The benefits could be improvement in different types of attention for you students. The Autism Specialist thought this classroom and its students would be appropriate for my study. Would you and your students be possibly interested in some music therapy?"

After the script, the lead researcher will ask if the classroom teacher is interested. If the classroom teacher is interested, the lead researcher will give copies of the parental consent for the teacher to distribute to the students' parents.

APPENDIX C: EMAIL SAMPLE SCRIPT

Email Sample Script

(Request for Permission to Access the School)

Dear _____ (Principal),

I'm Vienna Sa and a Master's student at the University of the Pacific's Music Therapy Program. My thesis looks at the effect of Musical Attention Control Training (MACT) on attention skills of pre-adolescents with Neurodevelopmental Delays. I'm looking for participants diagnosed with Autism Spectrum Disorder and are between the age ranges of 11-14 years old. The MACT protocol is typically used to improve different types of attention.

I have been in contact with Angela Dunne and Lana Scott, the autism specialists, and they directed and introduced me to certain classrooms with the ideal age and population for my research study. The lead researcher have spoken to the selected classroom teachers_____, _____, and about the study and how the topic might benefit their students.

If your students and their parents consent to participate in the study, they will be attending 45-minute music therapy sessions once a week for a period of 6 weeks. The music therapy session will include the use of MACT and involve various musical activities designed to address different types of attention. The benefits could be improvement in different types of attention for you students. Would you allow your students to partake in some music therapy?

APPENDIX D: MACT SESSION PLAN

MACT Session Plan 1

Music Therapist: Vienna Sa
Date: 4/4/19
Client Group: Ms. M's Class
Site: P Elementary

Goal 1: To improve attention skills

Objective 1.1: The client will increase their TEA-Ch2 scores by 3 points by the end of the series of 6 MACT-specific sessions by May 24th, 2019.

Data Collection:

Objective 1.1: Standardized attention measures

Sequence of Interventions:	**Behavior(s) Being Observed:**
Opening Song	Come and Feel the Beat
Share Your Rhythm	Sustained Attention (1.1)
Clashing Leaders	Alternating Attention (1.1)
Ignore the Fly	Selective Attention (1.1)
Closing Song	Na, Na, Na

INTERVENTION: Share Your Rhythm

REFERENCE: Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 211 (Thaut, 2008)

NMT Technique: MACT SUSTAINED (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: A variety of percussion instruments in containers ready for easy distribution to the group; such as autoharp, guitar, or piano

Description/Task Analysis:

1. Using a drum or other rhythm instrument, the group leader plays a simple, sustained rhythm.
2. The group members are invited to join with the rhythm.
3. The leader ends the rhythm by counting down- "5, 4, 3, 2, 1," -and then stops.
4. Each group member is given the opportunity to introduce a rhythm to the group, lead the group in producing the rhythm, and stop the group with whatever cue he or she devises.

INTERVENTION: Clashing Leaders

REFERENCE: Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 213 (Thaut, 2008)

NMT Technique: MACT ALTERNATING (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: A variety of percussion instruments, autoharp, guitar or piano

Description/Task Analysis:

1. Arrange the group in a horseshoe shape and pass out rhythm instruments.
2. Have two leaders sit facing the group
3. Leader #1 will teach rhythm pattern #1
4. Leader #2 will teach rhythm pattern #2
5. Leader #1 will start the group and lead it through a few bars of the rhythm, then stop. Without missing a beat, leader #2 will lead the group with his or her rhythm, then stop after a few bars. Leader #1 will then begin again. They will switch back and forth until both leaders stop.

INTERVENTION: Ignore the Fly

REFERENCE: Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 209 (Thaut, 2008)

NMT Technique: MACT SELECTIVE (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: A variety of percussion instruments

Description/Task Analysis:

1. The group is seated in a circle.
2. Rhythm instruments are distributed to the group.
3. Two people are chosen from the group- a leader and a “heckler”
4. Using drums or other rhythm instruments, the group leader plays a simple, sustained rhythm.
5. The group members are invited to join with the rhythm.
6. The heckler, who is given a loud, distinct instrument, attempts to disrupt the rhythm by playing a rhythm that is contrary to that of the leader.
7. The leader ends the rhythm.
8. Other group members are given the opportunity to be the leader and the heckler.
9. The group discussion the experience from three angles: being a group member, being a heckler, and being a leader.

APPENDIX E: MACT SESSION PLAN 2

MACT Session Plan 2

Music Therapist: Vienna Sa
Date: 4/4/19
Client Group: Ms. M's Class
Site: P Elementary

Goal 1: To improve attention skills

Objective 1.1: The client will increase their TEA-Ch2 scores by 3 points by the end of the series of 6 MACT-specific sessions by May 24th, 2019.

Data Collection:

Objective 1.1: Standardized attention measures

Sequence of Interventions:	**Behavior(s) Being Observed:**
Opening Song	Come and Feel the Beat
Are We Ready?	Sustained Attention (1.1)
Clashing Leaders (Closed Eyes)	Alternating Attention (1.1)
Triangle Time	Selective Attention (1.1)
Closing Song	Na, Na, Na

INTERVENTION: Are We Ready?

REFERENCE: Handbook of Neurologic Music Therapy 21.5.4 (Thaut & Hoemberg, 2016)

NMT Technique: MACT SUSTAINED (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: Pitched instruments (e.g. xylophones, metallophones, marimba) and non-pitched instruments (e.g. drums, timpani, congas, bongos, roto toms, hand drums).

Description/Task Analysis:

1. The therapist and client play together on musical instruments, with the client following as closely as possible the variation introduced by the therapist
2. Elements of musical variation that the therapist can use include the following: changes between play and rest, changes in tempo, changes in rhythmic pattern, changes in note duration, changes in loudness, changes in pitch/register
3. If pitched instruments are used, the therapist should only use single pitches or melodic lines, and never use chord structures, so that the client can follow easily.
4. The task difficulty should be structured around two dimensions, namely the number of change elements and the duration of the exercise.
5. Depending on the client's attention level, the therapist may use only one change initially for a short period of time that is as long as the client can attend.

6. The best baseline variation is play vs. rest, because if focuses on the basic auditory attention function of "sound present" vs. "sound absent". The therapist may then add sequentially other variations one at a time with increasingly long exercise duration. At higher levels of attention function the therapist may eventually challenge the client's sustained attention capability by mixing all of the change elements.

INTERVENTION: Clashing Leaders (Closed Eyes)

REFERENCE: Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 213 (Thaut, 2008)

NMT Technique: MACT ALTERNATING (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: A variety of percussion instruments, autoharp, guitar or piano

Description/Task Analysis:

1. Arrange the group in a horseshoe shape and pass out rhythm instruments.
2. Have two leaders sit facing the group
3. Leader #1 will teach rhythm pattern #1
4. Leader #2 will teach rhythm pattern #2
5. Ask the listeners to close their eyes
6. Leader #1 will start the group and lead it through a few bars of the rhythm, then stop. Without missing a beat, leader #2 will lead the group with his or her rhythm, then stop after a few bars. Leader #1 will then begin again. They will switch back and forth until both leaders stop.

INTERVENTION: Triangle Time

REFERENCE: Handbook of Neurologic Music Therapy 21.5.5 (Thaut & Hoemberg, 2016)

NMT Technique: MACT SELECTIVE (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: Pitched instruments (e.g. xylophones, keyboard, chromatic marimba, triangle) and non-pitched instruments (e.g. drums, timpani, congas, bongos, hand drums).

Description/Task Analysis:

1. The therapist and client play together following a basic improvisational scheme, and every so often in random sequence a specific musical cue appears to which the client has to respond musically. For example, the therapist and client play on two xylophones in Dorian mode in free heterophony.

2. At random moments in the improvisation the therapist plays a distinct melodic motif of 3 o4 notes which has been shown to the client before the start of the improvisation and which is never played during the basic improvisation.
3. If the therapist plays on a keyboard or on a chromatic marimba, the motif could be using accidentals to highlight the distinction.
4. The therapist could also have a second instrument (e.g. a triangle) ready that they strike at random moments during the improvisation.
5. The task for the client is to give a specific musical response to the "signal". One of the more basic responses would be to stop playing when the signal sounds and resume playing when the signal occurs again.

APPENDIX F: MACT SESSION PLAN 3

MACT Session Plan 3

Music Therapist: Vienna Sa
Date: 4/4/19
Client Group: Ms. M's Class
Site: P Elementary

Goal 1: To improve attention skills

Objective 1.1: The client will increase their TEA-Ch2 scores by 3 points by the end of the series of 6 MACT-specific sessions by May 24th, 2019.

Data Collection:

Objective 1.1: Standardized attention measures

Sequence of Interventions:	**Behavior(s) Being Observed:**
Opening Song	Come and Feel the Beat
The Rhythm's in my Hand	Sustained Attention (1.1)
Xylophone Fun	Alternating Attention (1.1)
Listen to the Song	Selective Attention (1.1)
Closing Song	Na, Na, Na

INTERVENTION: The Rhythm's in My Hand

REFERENCE: Handbook of Neurologic Music Therapy 21.5.4 (Thaut & Hoemberg, 2016)

NMT Technique: MACT SUSTAINED (Music Attention Control Training)

TME: Body Percussion

Materials Needed: None

Description/Task Analysis:

1. The therapist and client play together on a certain beat using body percussion, with the client following as closely as possible to the variation introduced by the therapist
2. Elements of musical variation that the therapist can use include the following: changes between play and rest, changes in tempo, changes in rhythmic pattern, changes in note duration, changes in loudness, changes in pitch/register
3. The clients must follow the therapist's changing directions
4. The clients then get a turn

INTERVENTION: Xylophone Fun

REFERENCE: Adapted from Demonstration by Thaut (NMT Training June '19, Milwaukee, WI)

NMT Technique: MACT ALTERNATING (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: A variety of percussion instruments and Xylophone

Description/Task Analysis:

1. Arrange the group in a horseshoe shape and pass out rhythm instruments.
2. Have one client have the xylophone
3. When the client plays on the higher register, the group must play the sticks
4. When the client plays on the lower register, the group must play the drums
5. Switch clients

INTERVENTION: Listen to the Song

REFERENCE: Adapted from Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 217 (Thaut, 2008)

NMT Technique: MACT SELECTIVE (Music Attention Control Training)

TME: Music Listening (Instrument playing)

Materials Needed: Non-pitched instruments (e.g. drums, timpani, congas, bongos, hand drums).

Description/Task Analysis:

1. The therapist asks for a song preference
2. The therapist plays the song and asks to listen to a certain word
3. When the client identifies the word, they play the drum

APPENDIX G: MACT SESSION PLAN 4

MACT Session Plan 4

Music Therapist: Vienna Sa
Date: 4/4/19
Client Group: Ms. M's Class
Site: P Elementary

Goal 1: To improve attention skills

Objective 1.1: The client will increase their TEA-Ch2 scores by 3 points by the end of the series of 6 MACT-specific sessions by May 24th, 2019.

Data Collection:

Objective 1.1: Standardized attention measures

Sequence of Interventions:	**Behavior(s) Being Observed:**
Opening Song	Come and Feel the Beat
Drum Master.	Sustained Attention (1.1)
Clashing Leaders	Alternating Attention (1.1)
Listen to the Song (V2)	Selective Attention (1.1)
Closing Song	Na, Na, Na

Description/Task Analysis:

1. The therapist and client play together on a certain beat, with the client following as closely as possible the variation introduced by the therapist
2. Elements of musical variation that the therapist can use include the following: changes between play and rest, changes in tempo, changes in rhythmic pattern, changes in note duration, changes in loudness, changes in pitch/register
3. The clients must follow the therapist's changing directions
4. The clients then get a turn

INTERVENTION: Drum Master

REFERENCE: Adapted from Handbook of Neurologic Music Therapy 21.5.4 (Thaut & Hoemberg, 2016)

NMT Technique: MACT SUSTAINED (Music Attention Control Training)

TME: Body Percussion

Materials Needed: Drum Sticks or Rhythm Sticks

Description/Task Analysis:

1. One person is chosen to be a seeker and is sent away to be called back later to find "The Leader"
2. There is one individual chosen in a group to be "The Leader"

3. The leader leads the group to play together on a certain beat using drum sticks or rhythm sticks, with the group following as closely as possible to the variation introduced by the leader
4. The seeker is then brought back and has to guess who the leader is making the changes within the group
5. Elements of musical variation that the leader can use include the following: changes between play and rest, changes in tempo, changes in rhythmic pattern, changes in note duration, changes in loudness, changes in pitch/register
6. The group must follow closely the leader's changing directions
7. Once the leader is found, another member from the group is chosen to be the seeker and another is chosen to be the leader.

INTERVENTION: Clashing Leaders

REFERENCE: Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 213 (Thaut, 2008)

NMT Technique: MACT ALTERNATING (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: A variety of percussion instruments, autoharp, guitar or piano

Description/Task Analysis:

1. Arrange the group in a horseshoe shape and pass out rhythm instruments.
2. Have two leaders sit facing the group
3. Leader #1 will teach rhythm pattern #1
4. Leader #2 will teach rhythm pattern #2
5. Ask the listeners to close their eyes
6. Leader #1 will start the group and lead it through a few bars of the rhythm, then stop. Without missing a beat, leader #2 will lead the group with his or her rhythm, then stop after a few bars. Leader #1 will then begin again. They will switch back and forth until both leaders stop.

INTERVENTION: Listen to the Song (V2)

REFERENCE: Adapted from Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 217 (Thaut, 2008)

NMT Technique: MACT SELECTIVE (Music Attention Control Training)

TME: Music Listening (Instrument playing)

Materials Needed: Non-pitched instruments (e.g. drums, timpani, congas, bongos, hand drums).

Description/Task Analysis:

1. The therapist asks for two song preferences
2. The therapist plays the song and asks to listen to a certain word
3. When you the client identifies the word, they play the drum
4. As the chosen song is playing, the therapist plays another song simultaneously to distract from the original song
5. The group must listen closely for the chosen word in the original song and ignore the distracting song

APPENDIX H: MACT SESSION PLAN 5

MACT Session Plan 5

Music Therapist: Vienna Sa
Client Group: Ms. M's Class
Date: 4/4/19
Site: P Elementary

Goal 1: To improve attention skills

Objective 1.1: The client will increase their TEA-Ch2 scores by 3 points by the end of the series of 6 MACT-specific sessions by May 24th, 2019.

Data Collection:

Objective 1.1: Standardized attention measures

Sequence of Interventions:	**Behavior(s) Being Observed:**
Opening Song	Come and Feel the Beat
Drum Master	Sustained Attention (1.1)
Clashing Leaders	Alternating/Switching Attention (1.1)
Ignore the Fly (V2)	Selective Attention (1.1)
Closing Song	Na, Na, Na

INTERVENTION: Drum Master

REFERENCE: Adapted from Handbook of Neurologic Music Therapy 21.5.4 (Thaut & Hoemberg, 2016)

NMT Technique: MACT SUSTAINED (Music Attention Control Training)

TME: Body Percussion

Materials Needed: Drum Sticks or Rhythm Sticks

Description/Task Analysis:

1. One person is chosen to be a seeker and is sent away to be called back later to find "The Leader"
2. There is one individual chosen in a group to be "The Leader"
3. The leader leads the group to play together on a certain beat using drum sticks or rhythm sticks, with the group following as closely as possible to the variation introduced by the leader
4. The seeker is then brought back and has to guess who the leader is making the changes within the group
5. Elements of musical variation that the leader can use include the following: changes between play and rest, changes in tempo, changes in rhythmic pattern, changes in note duration, changes in loudness, changes in pitch/register
6. The group must follow closely the leader's changing directions

7. Once the leader is found, another member from the group is chosen to be the seeker and another is chosen to be the leader.

INTERVENTION: Clashing Leaders

REFERENCE: Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 213 (Thaut, 2008)

NMT Technique: MACT ALTERNATING (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: A variety of percussion instruments, autoharp, guitar or piano

Description/Task Analysis:

1. Arrange the group in a horseshoe shape and pass out rhythm instruments.
2. Have two leaders sit facing the group
3. Leader #1 will teach rhythm pattern #1
4. Leader #2 will teach rhythm pattern #2
5. Ask the listeners to close their eyes
6. Leader #1 will start the group and lead it through a few bars of the rhythm, then stop. Without missing a beat, leader #2 will lead the group with his or her rhythm, then stop after a few bars. Leader #1 will then begin again. They will switch back and forth until both leaders stop.

INTERVENTION: Ignore the Fly (V2)

REFERENCE: Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 209 (Thaut, 2008)

NMT Technique: MACT SELECTIVE (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: A variety of percussion instruments

Description/Task Analysis:

1. The group is seated in a circle.
2. Rhythm instruments are distributed to the group.
3. Three people are chosen from the group- a leader and two “hecklers”
4. Using drums or other rhythm instruments, the group leader plays a simple, sustained rhythm.
5. The group members are invited to join with the rhythm.
6. The hecklers, who are given loud, distinct instrument, attempts to disrupt the rhythm by playing a rhythm that is contrary to that of the leader.
7. The leader ends the rhythm.

8. Other group members are given the opportunity to be the leader and the hecklers.
9. The group discussion the experience from three angles: being a group member, being a heckler, and being a leader.

APPENDIX I: MACT SESSION PLAN 6

MACT Session Plan 6

Music Therapist: Vienna Sa
Client Group: Ms. M's Class
Date: 4/4/19
Site: Pulliam Elementary

Goal 1: To improve attention skills

Objective 1.1: The client will increase their TEA-Ch2 scores by 3 points by the end of the series of 6 MACT-specific sessions by May 24th, 2019.

Data Collection:
Objective 1.1: standardized attention measures

Sequence of Interventions:	**Behavior(s) Being Observed:**
Opening Song	Come and Feel the Beat
Share your Rhythm	Sustained Attention (1.1)
Red Light Green Light	Alternating/Switching Attention (1.1)
Listen to the Song (V3)	Selective Attention (1.1)
Closing Song	Na, Na, Na

INTERVENTION: Share Your Rhythm

REFERENCE: Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 211 (Thaut, 2008)

NMT Technique: MACT SUSTAINED (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation on Percussion Instruments

Materials Needed: A variety of percussion instruments in containers ready for easy distribution to the group; such as autoharp, guitar, or piano

Description/Task Analysis:
1. Using a drum or other rhythm instrument, the group leader plays a simple, sustained rhythm.
2. The group members are invited to join with the rhythm.
3. The leader ends the rhythm by counting down- "5, 4, 3, 2, 1," -and then stops.
4. Each group member is given the opportunity to introduce a rhythm to the group, lead the group in producing the rhythm, and stop the group with whatever cue he or she devises.

INTERVENTION: Red Light, Green Light

REFERENCE: Adapted from Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 213 (Thaut, 2008)

NMT Technique: MACT ALTERNATING (Music Attention Control Training)

TME: Instrument playing/ Instrument Improvisation with Dance/Movement

Materials Needed: Two percussion instruments with different colors and timbres (e.g. shaker and tambourine)

Description/Task Analysis:

1. Arrange the group in a horseshoe shape and choose one client to hold the shaker and one client to hold the tambourine
2. Leader #1 who is playing the tambourine will signal to the group to move our bodies freely in the given space
3. Leader #2 who is playing the shaker will signal to the group to freeze and stop moving.
4. Leader #1 will start the group and lead them into movement. Leader #2 will begin playing the shaker and signal to Leader #1 to stop playing and the group to freeze and cease movement.
5. Leader #1 will then begin again. They will switch back and forth until both leaders stop.
6. Switch clients

INTERVENTION: Listen to the Song (V3)

REFERENCE: Adapted from Rhythm, Music, and the Brain Scientific Foundations and Clinical Applications p. 217 and p. 209 (Thaut, 2008)

NMT Technique: MACT SELECTIVE (Music Attention Control Training)

TME: Music Listening (Instrument playing)

Materials Needed: Non-pitched instruments (e.g. drums, timpani, congas, bongos, hand drums) and one tambourine

Description/Task Analysis:

1. The therapist asks for a song preference
2. One person is chosen from the group as a "heckler" and is given a tambourine
3. The therapist plays the song and asks the group to listen to a certain word
4. When the client identifies the word, they play the drum
5. The heckler, who is given a loud, distinct instrument, attempts to disrupt the listening of the chosen song
6. Other group members are given the opportunity to be the heckler.