THESIS

SUNG VERSUS VERBAL DIRECTIVES WITH YOUNG ADULTS DIAGNOSED WITH AUTISM

Submitted by

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ABSTRACT

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Autism Spectrum Disorder is a Pervasive Developmental Disorder characterized by deficits in three main areas: social interaction, communication, and an intense resistance to change which could include repetitive, self-stimulatory behaviors according to the American Psychiatric Association (2000). The National Institutes of Health and the U.S. Department of Health and Human Services (2012) defines a receptive language disorder as exhibited by an inability to understand the words of others, difficulties enacting verbal directives, and deficits in thought organization. These deficits can cause individuals to have difficulties while participating in school, home, and social situations, and may lead to problem behaviors. The U.S. Department of Health and Human Services (2012) has linked receptive language disorders with other disabilities including Autism Spectrum Disorder (Hoch, 2012). Because this is a largely unexplored area, research is needed to find and support therapeutic techniques addressing deficits in receptive language.

Three young adult males between the ages of 14 and 22 with a primary diagnosis of Autism Spectrum Disorder were recruited by flyer and word-of-mouth from Northern Colorado. This study employed a multiple baseline across participants with repeated measures design. There were a total of 6 experimental observations with each research subject. Behavioral coding was utilized to determine if there were any mean time differences between the sung and verbal directive conditions.

Because data was coded separately by the researcher and research assistant, Pearson's r was used to test inter-rater correlation through Statistical Package for Social Sciences (SPSS) software (IBM Corporation, 2012). Pearson's $r = + 0.997$ signifying a positive correlation between the two coders. A Repeated Measures of Analysis of Variance was applied using SAS software to test for statistical significance between the verbal and sung conditions (SAS Institutue Inc., 2011). The RM ANOVA yielded no statistically significant results. However the p value of the statistic, $p = 0.0769$, was very close to the p value set for the present study, $p < 0.05$. A power analysis revealed that if an average of 10.2 seconds with a standard deviation of 6.8 seconds remained constant after recruiting a total of 7 volunteer participants, then statistical significance could be reached. Even though statistical significance was not reached, trends in the data were discussed.

Overall there was a decrease in time between the verbal and sung conditions for each participant. However, this trend was not clear and variability was seen among the participants throughout the sung observations after separating and plotting the data on bar and line graphs. Future researchers should increase the sample size and eliminate inherent study design flaws to thoroughly test if there is a difference between the verbal and sung directives.

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DEDICATION

I dedicate this thesis to my brother, Josh. The answers to the big questions like "What should I do with the rest of my life?" are not always easy, and the path to the answers can pose risk. However nothing can make a person stronger than when walking the road less traveled and coming out knowing you can do anything and everything with a little hard work and perseverance. May this inspire him to follow and achieve his dreams.

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CHAPTER 1: INTRODUCTION

Autistic Disorder is a Pervasive Developmental Disorder from the group of Autism Spectrum Disorders (ASD) categorized in the *Diagnostic and Statistical Manual of Mental Disorders 4th Edition Text Revision* published by the American Psychiatric Association in 2000 (American Psychiatric Association, 2000a; The National Institute of Neurological Disorders and Stroke, 2011). Currently, it is projected that autism affects 1 in 88 children, with more boys being affected than girls (Autism Speaks Inc., 2013). This is an increase from 1 in 110 children in 2011 (Autism Speaks Inc., 2011). In 2009, only 33% of adults with autism possessed occupational employment (Standifer, 2012), and more than 50% of young adults with Autism in the United States of America who graduated high school two years prior were unemployed and not participating in any type of higher education or vocational training in 2012 (Shattuck et al., 2012). That means the majority of adults diagnosed with autism do not possess any ability to support themselves. These individuals rely completely on others for financial assistance. With early diagnosis and continuous therapeutic intervention, the total cost of living for an individual with autism can be reduced by as much as two-thirds (Autism Society, 2011). Therefore research is greatly needed to find and develop therapies addressing deficits in autism that prevent individuals with the disorder from being able to find and retain employment.

Individuals diagnosed with ASD exhibit difficulties with socialization, deficits in communication, and an intense resistance to change that could include repetitive routines and/or behaviors. People require both receptive and expressive communicative skills in conjunction with social skills in order to participate in society and real world situations. According to the National Institutes of Health and the U.S. Department of Health and Human Services (2012), receptive communication disorder can cause difficulties with socialization and deficits in the ability to function independently (Hoch, 2012). Therefore, there is a need for effective interventions that improve deficits in receptive communication.

Because the cause of ASD is unknown, researchers can only speculate about the source of receptive communication deficits. The American Psychiatric Association postulates that the core deficits in Autistic Disorder are related to some type of environmental factor combined with some genetic predisposition (American Psychiatric Association, 2000a). Until researchers can pinpoint the exact cause of autism, therapies will have to continue to develop interventions that target specific deficits such as difficulties in receptive communication (Autism Speaks Inc., 2011).

A particular deficit related to receptive communication is the inability to successfully complete verbal directives. Individuals with Autism Spectrum Disorders often exhibit impairments in responding to one's name verbalized by another individual and socially making eye contact with people, and they will focus on one thing while excluding all others (American Psychiatric Association, 2000; Autism Speaks Inc., 2011; NINDS, 2011). All of these impairments can directly affect the successful completion of the tasks of daily living, such as following directives from parents or teachers, and any other situations where verbal directives are utilized. Verbal directives are communicated during a vast variety of real world situations, including: during and between school tasks, while eating out at restaurants, during shopping trips, while performing duties at an occupation, before and while completing household chores, and while playing sports. These are just a few of the many social situations requiring the successful completion of verbal directives. An inability to comprehend and successfully complete verbal directives seriously hinders an individual's ability to participate in society and lead a typical life.

One therapy making great strides with individuals with autism is music therapy. The use of music in therapy for individuals with ASD is not a new concept. In 1952, Mahler reported that a young client with autism who was unable to engage in social interaction with others seemed to show an interest in music. He then proposed that the various musical elements such as melody, rhythm, and singing could be used to help engage children with autism in social activities. Since then, other publications have reported the innate musical abilities of individuals with autism and their preferences for music-based interventions. In 2006, a meta-analysis of music therapy treatments and results during three different studies was conducted by Gold, Wigram, and Elefant. Results indicated that music therapy was statistically significant in increasing and improving verbal and nonverbal communication skills in children with autism in comparison to the placebo therapies in the studies (Gold, Wigram, & Elefant, 2006). Even though these studies reported an indication that children with ASD respond to music, these studies were examining expressive communication. No data has been found examining the use of music in treating receptive communication deficits. Research is needed to specify what specific musical characteristics and therapeutic music interventions produce the greatest developments and improvements in the receptive language abilities of individuals with ASD.

Music therapy professionals will often use sung directives with children with ASD. Both Meredith Powers and Bridget Kulik (2012), two board-certified music therapists employed at Giant Steps school for children and adolescents with the primary diagnosis of autism, utilize sung directives with their students daily. Both Powers and Kulik have witnessed that their students with ASD often exhibit difficulties with processing verbal information. They each wrote a letter to this researcher describing why they utilize sung directives with their students. Powers wrote, "Because people with autism have difficulty with auditory perception, I hypothesized that they may process sounds more easily with decreased white noise" (personal communication, April 25, 2012). Kulik noted, "I continue to observe my students increased independence with successful completion of one-step and two-step directives when the directives are sung versus spoken…as a result of the implementation of sung directives, anxiety levels and frustration decreases and a willingness to try novel tasks increases" (personal communication, April 25, 2012). Therefore both music therapists continue to utilize sung directives with their students and consistently see positive results. However, there is no research supporting the use of sung directives. Therefore, research is needed in order to determine if singing is an effective music therapy technique in addressing deficits in receptive language with individuals with ASD.

Problem Statement

The study incorporated sung and verbal directives within the home of each volunteer participant. The purpose of this study was to determine the effects of using verbal directives versus sung directives with young adults with the primary diagnosis of ASD.

Hypotheses

The null hypothesis predicted that there would be no statistically significant differences between the successful completion of verbal directives and sung directives with young adults with ASD. The following secondary hypotheses were also developed in order to thoroughly test the null hypothesis: (1) there would be a decrease in the amount of time needed to successfully complete sung directives; (2) there would be a decrease in the number of re-directives needed to complete the sung directives; and (3) there would be a decrease in the number of prompts needed to complete the sung directives.

Delimitations

This study was delimited to three young adult subjects within a 30 mile radius of Fort Collins, Colorado. The population of interest was young adults with the primary diagnosis of Autism Spectrum Disorder. The sample population was recruited by flyer and word-of-mouth throughout Fort Collins, Colorado.

Limitations

This study did have some inherent limitations. The sample size of three subjects was small and the results could not be applied to the entire population of young adults with autism within Colorado or across the United States. The use of the same directives and presentation order during both sung conditions and spoken conditions may have resulted in the subjects becoming acclimated to the directives and their order, and the outcomes may not have been necessarily due to their sung or verbal presentation. Also, results could have been potentially affected by novelty. The researcher was a novel adult figure within the home in comparison to the participants' family members. In addition the participants' parents and/or guardians did not use singing on a regular basis with the participants. Finally, the duration of the study was short totaling 6 experimental sessions with each participant. Later replication studies should look at increasing the number of participants, lengthening the study, and randomly selecting the order of the pre-determined directives with each participant.

Potential Impact of Project

Because the etiology of autism is unknown and it results in a broad spectrum of behaviors, it is difficult to develop exact therapies to treat the disorder and to know the exact implications they could have on the population. Trying to find effective ways of teaching receptive language skills to individuals with autism is a conundrum in itself. However, every bit of research added to the repertoire of knowledge surrounding autism helps to bring therapy one step closer to doing this. The results of this study could have significant implications for autism symptom treatments. The results of this study suggest that sung information –as opposed to verbal information –is possibly more accurately attained by the neuronal decoding units of individuals with autism. If this is the case, then using sung information as an alternative teaching method within home and school environments could have a major influence on the current educational philosophies with this population. Furthermore, these results could affect how information is socially communicated to individuals with ASD within various environments, and also significantly influence how this population communicates with the outside world.

Definitions of Terms

The following terms were defined for the purpose of this study. All definitions were formulated from definitions in the online Merriam-Webster Dictionary unless otherwise specified.

Pragmatics refers to the ways in which context or situation contributes to verbal meaning. This also involves using language appropriately with in social situations by understanding the meaning of what others are saying (Merriam-Webster Online, 2011a).

Extralinguistic is a term used to refer to all aspects of speech not related to language. This also refers to the musical aspects of speech such as voice inflection (Merriam-Webster Online, 2011b).

Semantics refers to the meaning of language (Merriam-Webster Online, 2011c).

Phonology refers to the speech sounds of language, such as the rules surrounding verbal pronunciation (Merriam-Webster Online, 2011d).

Syntax refers to the rules in which words combine to form phrases, clauses, and sentences. This also means the arrangement of words or phrases to create comprehendible sentences (Merriam-Webster Online, 2011e).

Broca's Area refers to a region within the left frontal lobe that controls the motor aspects of speech. Individuals with damage to Broca's Area have difficulty producing speech and their speech is often slurred and broken. However, these individuals are still capable of understanding verbal speech (Encyclopedia Britanica Online, 2011a).

Wernicke's Area refers to a region within the posterior superior temporal lobe. Individuals with damage to this area exhibit deficits in speech comprehension. They often are able to verbalize words normally, but the words are strung together randomly and may not make much sense (Encyclopedia Britanica Online, 2011b).

Perceptual Speech Processing refers to the process by which a verbalization is a comprehendible and meaningful representation deciphered by the listener utilizing language characteristics including phonetics, semantics, syntax, and grammar (Merriam-Webster Online, 2011f, 2011g, 2011h).

Pragmatic Language Impairment is usually associated with individuals with autism and Asperger's Syndrome and includes problems with understanding the meaning of what is said and using language appropriately in social situations (Early Intervention Support, 2010).

Mirror Neuron System (MNS) is a neuronal network within the brain that responds while observing others' actions and while performing actions. It has been proposed and hypothesized that the deficits of autism are a direct result of a dysfunctioning mirror neuron system. This hypothesis has lead to the proposal that individuals with autism need to engage in therapies that utilize processing networks that overlap with the MNS such as music therapy (Wan, Demaine, Zipse, Norton, & Schlaug, 2010).

Theory of Mind refers to the ability to understand another person's perspective, including their beliefs, intents, and desires as separate from one's own thoughts, experiences, and behaviors" (Wan, Demaine, et al., 2010, pg. 161).

Receptive Language Disorder is characterized by the inability to understand verbal and nonverbal language communicated by others. This can lead to difficulties in understanding the words of others, organizing personal thoughts, and successfully enacting verbal directives (Hoch, 2012).

CHAPTER 2: LITERATURE REVIEW

Previous researchers have examined the use of music interventions with individuals with autism for the development of language and the improvement of social interaction, but not specific to receptive language (Brownell, 2002; Lim, 2010a, 2010b). This chapter details previous literature pertinent to this study. The information is organized as follows: (1) theories of neural dysfunction in autism; (2) language comprehension; (3) music processing; (4) shared neuronal networks; and (5) evidence of music therapy with autism.

Autism Spectrum Disorder is a very complex neurological disorder that affects four times as many males as females (American Psychiatric Association, 2000; NINDS, 2011). In order to be diagnosed with autism, an individual must show signs of the disorder before 36 months of age. However, the actual diagnosis of autism can come after 36 months as long as deficits in social interaction, impairments in communication, and a strict adherence to daily routines—possibly combined with self-stimulatory behaviors—arise before age three (American Psychiatric Association, 2000a). To date, autism is considered one of the fastest growing types of pervasive developmental disorders in the United States (Autism Speaks Inc., 2011).

According to the National Institute for Neurological Disorders and Stroke (2011), many professionals compare the increased percentage of ASD diagnoses with a disease epidemic. Even though the cause of autism is unknown, professionals believe that the disorder results from a combination of a predisposing genetic condition and an environmental factor (NINDS, 2011). Specialists with the American Psychiatric Association (2000) agree that the best treatment plans for individuals with ASD are specialized to meet the needs of each individual. For most individuals, language is learned through natural environmental observation. Speech development is inhibited when complications occur before the age of four, such as a loss of hearing, an inability to remember information, and difficulties seeing and understanding the world. The National Institutes of Health and the U.S. Department of Health and Human Services (2012) have linked receptive language disorders with other developmental disabilities, including ASD. Individuals with receptive language deficits exhibit difficulties in language understanding or comprehension. “This may include a hard time understanding what other people have said, problems following directions that are spoken to them, or problems organizing their thoughts” (Hoch, 2012). Receptive language disorders can lead to other lasting difficulties in the areas of language, learning, reading, and socialization, and they can contribute to or aggravate depression, anxiety, problem behaviors, and a decreased ability to function independently. All of the formerly stated deficits are comorbid with the developmental disorder Autism Spectrum Disorder. Since these deficits are associated with ASD, developing therapies to specifically target receptive language disorders could prove to be quite beneficial in the treatment of individuals with ASD (Hoch, 2012).

Theories of Neural Contributions to Autism

Avikainen, Wohlschläger, Liuhanen, Hänninen, and Hari (2003) propose that the deficits in the language and communication abilities of individuals with autism relate to abnormalities within the human mirror neuron system (MNS). Learning to communicate occurs early in life and is acquired through a great deal of imitation. In their study, individuals with autism performed at the same level during writing tasks with and without an individual mirroring the movement for the subjects during the task. This suggests further that individuals with autism show great difficulty in relating to and understanding others around them (Avikainen, Wohlschläger, Liuhanen, Hänninen, & Hari, 2003; Boria et al., 2009). As described above, an inability to relate to others within the environment can contribute to receptive language disorders (Hoch, 2012). These could then contribute to the receptive language deficits in individuals with autism.

Other studies have suggested that deficits in imitation and socialization result from impairments within the mirror neuron system in individuals with autism. MRI studies have revealed decreased grey matter density in the MNS regions associated with social skills and imitation in individuals with autism, specifically in the Inferior Frontal Gyrus Pars Opercularis (IFG Pars Opercularis), the Inferior Parietal Lobule (IFL), and the Superior Temporal Sulcus (STS) (Hadjikhani, Joseph, Snyder, & Tager-Flusberg, 2006; Wan, Demaine, et al., 2010). During an EEG study in 2008 enacted by Oberman, Ramachandran, and Vilayanur, results implied that the observation of a familiar person resulted in a greater increase in brain activity than the observation of a complete stranger. Both the controls and research subjects in this study demonstrated a greater degree of neuronal firings while observing the hands of a familiar person than the hands of a complete stranger (Oberman et al., 2005). These results suggest that the MNS in individuals with autism is not broken but may malfunction when responding to movements by unfamiliar people (Fan, Decety, Yang, Liu, & Cheng, 2010; Oberman, Ramachandran, & Pineda, 2008). Malfunctioning severity within the MNS strongly correlated with the severity of the autism characteristics. Less activation within the MNS seemed to correlate with more severe deficits in communication (Fan et al., 2010). This could lead to imitation deficits in individuals with autism resulting in deficits in receptive communication (Avikainen et al., 2003; Fan et al., 2010; Oberman et al., 2005, 2008).

Wan, Demaine, et al. (2010) believe that deficits in communication result from deficits in “theory of mind,” or the inability to imitate individuals within the environment. The ability to see the world through the thoughts, beliefs, and experiences of others is fundamental for developing communication and social skills. Studies have linked “theory of mind” deficits to impairment in executive functioning and communication (Wan, Demaine, et al., 2010). Cranial areas processing motor, visual, and auditory information are interconnected and work together. Many scientists believe that imitation is a precursor of language (Wan, Demaine, et al., 2010). Le Bell, Pineda, and Sharma have suggested that the integration of these processes may also form language representations that are later extracted for verbal comprehension (Le Bel, Pineda, & Sharma, 2009). Dysfunction within the MNS could then possibly produce deficits in imitation leading to insufficiencies in communication and verbal comprehension which are characteristic of receptive language disorders.

Because music and speech share a variety of characteristics and neuronal processing networks, research has begun to study the use of singing in treating language impairments in people with neurological disorders. Studies have utilized fMRI and DTI to show that left hemisphere stroke survivor patients have exhibited brain plasticity after music therapy treatment through increased arcuate fasciculus fiber bundle density within the right hemisphere (Wan, Ruber, Hohmann, & Schlaug, 2010). If music can be used to increase brain plasticity in order to rehabilitate language functions in individuals with neurological impairments, then it is reasonable to theorize that music can be used to induce brain plasticity in individuals with ASD in order to habilitate receptive language abilities. In order to gain support for this theory, research is needed.

Similarly Auditory-Motor-Mapping Training (AMMT) incorporates imitative music interventions, singing, and motor movement in order to engage the MNS to treat communication deficits in autism (Wan, Demaine, et al., 2010; Wan, Ruber, et al., 2010). Brown, Martinez, Hodge, Fox, and Parsons (2004) observed that singing activates the frontal and temporal language circuits bilaterally to a greater degree than speech, which engages the mirror neuron system to a greater degree than speech (Brown, Martinez, Hodges, Fox, & Parsons, 2004). If singing activates the neural circuits for language comprehension better than verbal communication, then perhaps singing can be used to improve the receptive language deficits associated with ASD.

Taking into account the previously stated deficits in receptive communication, the possible malfunctioning of the MNS in individuals with autism, and their superior musical abilities which are discussed later, other professionals have suggested using music in the treatment of MNS dysfunction and language impairments in this population. Wan, Demaine, Zipse, Norton, and Schlaug analyzed all of the literature surrounding the MNS in individuals with autism in 2010. They found a vast amount of information supporting the use of music therapy to treat mirror neuron dysfunction and communication deficits associated with ASD. Group therapies that engage in musical interventions have shown to activate cortices that are shared with the MNS, and individuals with autism seem to enjoy and respond positively to music. Engaging in group music-making may address many of the social and communication deficits of autism by engaging individuals with the disorder in preferred tasks thus fostering receptive communication (Wan, Demaine, et al., 2010).

The MNS incorporates many language circuits, including the regions of Broca's area and the inferior frontal cortex. Successful speech perception relies on a variety of information processed simultaneously by the MNS. When an individual perceives speech, the auditory information is processed instantaneously with the motor information coming from the speaker's mouth movements and physical gestures. The listener takes in this verbal and motor information, and his or her brain cross checks that information with intact speech representations of spoken language in order to comprehend the speaker's full auditory meaning. This has led scientists to speculate that the motor system is important in auditory comprehension through the MNS. "The important function of the MNS in action understanding and vocal production, coupled with the hypothesis that autism is linked with mirror neuron dysfunction, suggests that strategies that engage and stimulate brain regions that are involved in action observation and may be part of the MNS, could potentially ameliorate some of the associated communication deficits" (Wan, Demaine, et al., 2010, pg. 165). Singing is a musical task that seems to engage the MNS. Thus singing could possibly be utilized to address the receptive language deficits of individuals with autism.

Language Comprehension

Typical population. In order to know what neuronal areas are abnormally functioning, the typical population must first be studied to provide a picture of the "normal" functioning brain. Once the brains of the typical population and other populations are mapped for certain functions, the maps can be compared and utilized when developing therapeutic techniques to target abnormal brain and behavior functions. A variety of publications have examined neurological activations within the typical human brain during language comprehension tasks. In 2004, Wilson, Saygin, Sereno, and Iacoboni conducted fMRI research studying brain activation while passively listening to and actively producing speech sounds. While passively listening to speech, bilateral activation occurred within the ventral pre-motor cortex. Activation within the same neuronal area occurred while producing speech. These results support the idea that brain regions recruited for speech comprehension are also utilized in the actual act of speaking (Wilson, Saygin, Sereno, & Iacoboni, 2004). Other fMRI studies have reported similar results.

Simultaneously processing auditory verbs and performing arm-reaching movements seem to interfere with one another neurologically as reported by Boulenger et al. (2006). However, when the verbs were processed before the reaching movement, the words actually helped in the execution of the reaching movement. These results infer that the processing of verbs shares common neural networks with the execution of motor movements (Boulenger et al., 2006).

Other fMRI studies have discovered neuronal activation in non-motor brain regions during language comprehension. While toddlers listened to verbal information, the greatest activation was observed in the frontal, cerebellar, and occipital brain regions in conjunction with the language areas located in the left superior temporal lobe. This supports the '*interactive specialization hypothesis'*. The hypothesis theorizes that the formation of cognitive functions develops through the collaboration of various brain areas and neural circuits in addition to the traditional temporal language areas in adults (Redcay, Haist, & Courchesne, 2008). That means these brain regions are utilized during language and non-language processes, including working memory, which is very important in attaining to and executing verbal directives. When interpreting verbal information, one must decipher its meaning both linguistically and extralinguistically, which implies interpreting the vocal inflection and the combined words together. Working memory and joint attention along with voice inflection, phonology, and semantics, are most likely major contributors to both verbal comprehension and receptive language abilities (C. Tesink, Petersson, et al., 2009; Redcay et al., 2008).

Tesink, Petersson, et al. (2009) studied the bilateral inferior frontal gyri and the left middle temporal gyrus and found that these cranial areas are involved when combining voice inflection, phonology, semantics, and world knowledge for full verbal comprehension. The left inferior frontal gyrus plays an integral role in language comprehension by connecting vocal inflection with both semantic and pragmatic information for full verbal interpretation (C. M. J. Y. Tesink et al., 2009). The study also demonstrated that there was less activation of the LIFG in children with autism than in typical functioning children. This then demonstrates that language is neurologically left-lateralized for the typically developing population. Because the bilateral inferior frontal gyri (Hamilton, Martin, & Burton, 2009) and the left posterior middle temporal gyrus all activate while interpreting and combining semantic information, speaker inflection, physical gestures, and previously learned information, most likely these cortical areas overlap to process both linguistic and extralinguistic information. Damage to the left inferior and middle frontal gyri produce language comprehension deficits relating to semantic retention for comprehension (C. M. J. Y. Tesink et al., 2009). Damage to the inferior parietal lobe within either hemisphere produces phonological processing deficits during language comprehension (Hamilton et al., 2009). Therefore, damage to any of the formerly stated neuronal regions prevents the retention of both phonological and semantic information which impedes an individual's ability to combine the auditory information for full verbal comprehension (Hamilton et al., 2009; C. M. J. Y. Tesink et al., 2009). An inability to comprehend verbal information would lead to severe deficits in receptive language abilities. Even though there is no research evidence supporting damage to these areas within the brains of individuals with ASD, the deficits of individuals with such damage are very similar to the language and communication deficits of individuals with autism. Therefore, research supporting the use of specific therapies to target the damaged brain areas for non-ASD populations could show promise with individuals with ASD. However, research is needed in order to support this generalization.

Autism spectrum disorder. To gain a better understanding of the communication deficits associated with Autistic Disorder, studies have appraised the differences in speech comprehension between individuals with autism and their age typical peers. Even though the left hemisphere is usually dominant for language processes, a SPECT (single-photon emission computed tomography) study in 1995 found that children with autism exhibited right hemispheric dominance for language processes (Chiron et al., 1995).

Further studies have found similar results confirming this asymmetry. Müller et al. found this same type of asymmetry in a 1999 study. Unlike the control group, the group with autism showed increased activation within the right hemisphere and decreased activation within the auditory cortex and the cerebellum during language processing. These results further suggest a reversed hemispheric dominance for language, along with abnormal functioning within the cerebellum of individuals with Autistic Disorder (Chiron et al., 1995; Herbert et al., 2002; Müller et al., 1999).

As imaging techniques grew more advanced, revealing greater brain asymmetry details and structural abnormalities, a greater understanding of the neural basis for the reversed asymmetry in individuals with autism began. In 2002, Herbert et al. conducted a study using Magnetic Resonance Imaging (MRI) to study brain asymmetry within the language cortices of 16 boys with autism. The subjects with autism exhibited asymmetry in the frontal and temporal language cortices in the cranial areas of Broca's area and Wernicke's area during verbal comprehension tasks. The right hemisphere enlargements in language areas in the subjects with autism were 27% larger than the exact same neural areas within the control subjects. The control subjects displayed left hemispheric language areas that were 17% larger than the experimental subjects. After a post hoc test, results revealed statistically significant reversed asymmetry in the left language cortices within the frontal lobes and the posterior temporal fusiform gyri of the subjects with autism (Herbert et al., 2002). This means that individuals with ASD had increased white matter volumes in the right hemisphere homologous to the left hemisphere language areas, and decreased white matter volumes in the left hemispheric language areas in comparison with age-equivalent typically functioning peers. Since the subjects with ASD exhibited increased activation within the right hemisphere during language tasks, and since music processing is slightly right-lateralized (explained in more detail below), this supports the theory that music can be utilized in the development of therapies treating receptive language deficits in autism.

The planum temporale has shown in previous studies by Belmonte et. al. (2004) and Herbert et. al. (2002) to play an integral role in auditory and verbal language processing, and could contribute to the multitude of language and communication deficits in autism. These results indicate that individuals with autism may utilize language areas in the right hemisphere in a greater capacity to compensate for dysfunctional language cortices in the left hemisphere (Belmonte et al., 2004; Herbert et al., 2002). Since individuals with autism may be using right hemispheric language areas to a greater capacity than left hemispheric language areas, and music is slightly right lateralized (see Music Processing section), then song could possibly be utilized to target receptive language disorders in individuals with ASD.

Since 2002, other published studies have confirmed cortical enlargements and asymmetries in individuals with autism. Herbert et al. conducted another study in 2004 examining cortical enlargements in individuals with both autism and language impairments in contrast to individuals with strictly Developmental Language Disorder (DLD) using white matter parcelization. Subjects with autism displayed increased white matter volumes in all four cerebral lobes. The subjects with DLD demonstrated increased white matter volumes in all lobes except the parietal. Also, all white matter enlargements were limited to the outer radiate zone white matter compartments. The greatest outer white matter zone enlargements were observed in the prefrontal cortices of the subjects with autism. More complex language and communication functions most likely rely on information processing between cortical areas across both hemispheres. White matter enlargement could disrupt this process by creating a greater number of white matter tracts. A greater amount of white matter tracts could increase the time it takes the brain to locate the desired tract and could increase the total time it takes for neuronal areas to communicate with one another throughout the brain (Herbert et al., 2004). A delay in auditory language processing could lead to a delay in language comprehension, thus resulting in deficits in receptive communication abilities.

In 2010, Hodge et al. explored reversed asymmetries in the cerebellum in children ages six to 13 with both autism and language impairment and those with just Specific Language Impairment (SLI) using cerebellum segmentation and parcellation with magnet resonance imaging (MRI). Results illustrated reversed asymmetry in cerebellar lobule VIII A in individuals with autism and language impairment and individuals with SLI. The subjects with SLI had smaller cerebellar lobule VII A crus I than the subjects with autism and language impairment. The anterior cerebellar vermis I-V were decreased in both subjects with autism and language impairment and subjects with SLI. After language performance test scores were analyzed, a correlation was found between cerebellar lobule VIII A asymmetry and decreased anterior vermis volumes. These results suggest that both groups, autism and SLI, exhibited structural malformations in fronto-corticocerebellar areas that play an integral role in cognitive functioning, language processing, attention, and working memory. These malformations, in combination with asymmetry reversal in Broca’s area, suggest that language comprehension for verbal information could be very difficult for children with autism and language impairment and for children with SLI. It is believed that the right posterior lateral cerebellum engages in widespread processing with the left frontal cortex resulting in a variety of functions, including language comprehension (Gebhart, Petersen, & Thach, 2002). Thus, asymmetry reversal in Broca's area could suggest a compensatory technique for this dysfunctional connection between the cerebellum and frontal cortex in individuals with language impairments (Hodge et al., 2010). The asymmetry could potentially result in deficits in receptive communication.

Music Processing

Typical population. Numerous studies have examined music processing within the brains of the typical population. Schlaug, Jäncke, Huang, and Steinmetz explored the neuronal differences between musicians and non-musicians in 1995. Musicians with absolute pitch exhibited increased asymmetry in the planum temporal, which contains the auditory association cortex. This suggests that perfect pitch correlates with increased left hemispheric asymmetry in the posterior superior temporal gyrus (Schlaug, Jäncke, Huang, & Steinmetz, 1995). Diffusion Tensor Imaging (DTI) has revealed that musicians with absolute pitch have a greater number of white matter connections within their temporal lobes for the detection and processing of pitch. The bilateral posterior superior and middle temporal gyri exhibited the greatest volumes of white matter increase, with a slight laterality for the left hemisphere (Loui, Li, Hohmann, & Schlaug, 2011). Absolute pitch seems to correlate with increased asymmetry and increased white matter volume in the left posterior superior temporal gyrus (Wernicke's Area) and the posterior middle temporal gyrus. These areas also play an integral role in the processing and comprehension of speech (Loui et al., 2011; Schlaug et al., 1995). As explained in greater detail earlier, individuals with autism exhibit increased left-hemispheric asymmetry in language association areas that resembles the asymmetry in individuals with perfect pitch (Herbert et al., 2002). This suggests that music could be utilized in the treatment of verbal comprehension and receptive language deficits.

Other researchers have examined neuronal activity during the processing of musical characteristics such as melody, harmonic progressions, singing, and rhythm. Music processing occurs throughout the entire brain by way of a vast variety of interconnected neural networks (Peretz & Zatorre, 2005). In 2001, Maess, Koelsch, Gunter, and Friederici studied musical syntax processing within the typical human brain using Magnetoencephalography (MEG). They found that both the left and right hemispheres within the frontal lobe were activated. Music was more right lateralized, which could indicate that the right side of the brain is more wired for the processing of harmonic progressions than the left side. The left hemisphere activation included regions within Broca’s Area. It was interpreted that this represented strong correlation between music and language processing (Maess, Koelsch, Gunter, & Friederici, 2001). Since individuals with autism exhibit increased left hemispheric asymmetry similar to people with perfect pitch, and since there seems to be a strong correlation between language and music processing, logically music could be used to target these neuronal areas within the brains of individuals with ASD to help treat receptive language disorders. Research is needed to support this theory.

Autism spectrum disorder. A variety of behavioral studies have also scrutinized overlapping language and music processing cortices in individuals with Autistic Disorder. Järvinen-Pasley, Wallace, Ramus, Happé, and Heaton in 2008 studied perceptual speech processing (processing the musical aspects of speech) in children with autism. When interpreting perceptual speech sounds, also known as the acoustics in speech, typical individuals focus on speech prosody, which is made up of pitch and intonation (McCleery et al., 2010). Subjects with autism exhibited a superior ability processing prosody, but not the semantics of verbal language. Participants with autism exhibited a great deal of difficulty developing meaning from verbal information, which is a sign of a receptive language disorder. However, they were able to perceive the perceptual aspects of speech and music with superior ability (Järvinen-Pasley, Wallace, Ramus, Happé, & Heaton, 2008). This suggests that incorporating music, specifically singing interventions, in therapy could help individuals with autism improve receptive language abilities.

Another study in 2009 conducted by Tesink et al. examined Pragmatic Language Impairment in adults with Autistic Disorder using fMRI. Results indicated cranial activation during sentences spoken with inflection out of context with the semantic representation in the right inferior temporal gyrus. This right-sided laterality was interpreted as a compensatory technique for the malfunctioning language areas in the left hemisphere (while integrating verbal semantic information with voice inflection). Increased right hemispheric activation during language comprehension also suggests an overflow of information from the left hemisphere, resulting from the inability to handle all of the incoming verbal information (C. Tesink et al., 2009).

The results of the previously stated studies indicate a superior ability by subjects with autism to process both the perceptual aspects of speech (musical aspects of speech) in comparison with control subjects. Since perceptual speech processing involves processing prosody, these results also suggest that individuals with autism would perhaps show a superior ability in processing the perceptual aspects of music. Lastly, these results suggest that individuals with autism pay particular attention to the acoustical aspects of speech instead of the semantic representations for full verbal sentence comprehension. This strength could be related to the right hemispheric laterality in individuals with autism during language comprehension

(Järvinen-Pasley et al., 2008; C. Tesink et al., 2009). Since music seems to be slightly right lateralized, singing could be implemented to increase and/or improve the receptive communication abilities of individuals with ASD.

Studies have revealed increased right hemispheric laterality during language comprehension, superior abilities in processing prosody, and superior abilities during music processing in individuals with ASD. In 2003 and then again in 2010, Bonnel et al. studied pitch processing between individuals with autism and typically functioning peers. Individuals with autism demonstrated a superior ability in processing pure tones. They also exhibited a superior ability in classifying individual pitches in comparison to the controls. These results support the idea that individuals with high functioning autism have an abnormally high sensitivity for processing musical pitches. These results also imply the possibility that this abnormally high pitch sensitivity could give individuals with autism superior musical processing abilities, which could then be utilized during therapy to treat receptive language impairments (Bonnel et al., 2003, 2010).

Shared Neuronal Networks

Typical population. As formerly mentioned, music processing is a widespread process that occurs throughout the entire brain. Neural processing regions for music often overlap with those for language. This could be a result of the defining characteristics of music that are also shared with language. In a paper written by Levitin and Tirovolas (2009), both music and language involve widespread neural processing units for higher-order cognitive functions. During verbal production, a series of sounds are combined in a systematic manner in order to produce words and sentences that convey full thoughts and meanings. The same is true for music. Melodic and harmonic progressions are made from a series of tones that are arranged and combined in a systematic manner in order to convey full thoughts and meanings. Both speech and singing use a variety of tonalities or pitch variations in order to convey meaning (Levitin & Tirovolas, 2009). Therefore, music could be utilized in therapy for people diagnosed with specific language impairment (Jentschke, Koelsch, Sallat, & Friederici, 2008).

During an ERP study conducted by Patel, Gibson, Ratner, Besson, and Holcomb in 1998, both language and music elicited an ERP response in identical brain structures with slight right hemisphere laterality for music and slight left hemisphere laterality for language. The researchers concluded that music and language are possibly processed similarly without specific neural specificity for one or the other (Patel, Gibson, Ratner, Besson, & Holcomb, 1998). In a similar study developed by Koelsch, Gunter, Wittfoth, and Sammler (2005), neural processing circuits were examined while typical individuals simultaneously processed auditory chord progressions while reading sentences. Results appeared to show overlapping neural circuitry in the premotor cortex and the ventrolateral premotor cortex (Broca's Area) when processing syntax within music and language (Koelsch, Gunter, Wittfoth, & Sammler, 2005). Understanding the correlation between music and language processing could help in identifying how music can be utilized in the treatment of receptive language disorders (Patel et al., 1998). As discussed earlier, studies have found individuals with ASD exhibit very similar language deficits to people with language disorders, along with exhibiting right hemispheric dominance for language even though language is typically a left dominant hemispheric process. Since music shows slight right hemispheric dominance, music and language seem to share a variety of neuronal circuits, and individuals with ASD exhibit a slight right laterality for language, then music could be utilized in the treatment of receptive language deficits in individuals with autism. More research is needed to support this theory.

In 2006, Brown, Martinez, and Parsons performed a PET study comparing the neuronal circuitry for sentence and melody generation, and sentence and melody processing. Shared brain mechanisms between melodic processing, sentence generation, and verbal processing included the following: the primary motor cortex, the supplementary motor area, Borca's Area, the anterior insula, the primary and secondary auditory cortices, the temporal pole, the basal ganglia, the ventral thalamus, and the posterior cerebellum. Differences really fell within the realm of laterality, the left hemisphere for language and the right for melody. Overlapping areas included those that are used for the phonological aspects of music and language during speaking and singing. The researchers speculated that this overlap in processing could be contributed to shared characteristics and shared representations between the two tasks, and memory encoding for the two tasks. This supports the notion that language and music share processing networks and could potentially affect one another (Brown, Martinez, & Parsons, 2006).

The production of music and simply listening to music activates a vast variety of neuronal networks across the entire brain that are also involved in non-musical processing such as cognitive, sensory, motor, communication, and emotional processing (Koelsch, 2009). Wong, Skoe, Russo, Dees, and Kraus (2007) established that adults with musical training exhibited superior abilities while distinguishing between words and inflections of Chinese speaking people than adults without musical training. These results suggest that the neuronal mechanisms utilized during the processing of verbal input are also active during the processing of melodic and harmonic input. Since brain structures utilized during the processing of verbal input share neural circuits with brain regions processing melodic and harmonic information, music could then be utilized to access verbal input neural circuits to help treat receptive language impairments in individuals with autism (Wong, Skoe, Russo, Dees, & Kraus, 2007).

Autism spectrum disorder. Experimental studies have also examined the overlap between music processing and language processing in individuals with autism. Using fMRI and Diffusion Tensor Imaging (DTI) in 2011, Lai conducted a study examining the neurocircuitry for both speech comprehension and music in subjects diagnosed with ASD. The subjects passively listened to speech, songs, and other non-speech sounds. During the fMRI portion, individuals with autism displayed a decreased degree of activation in the frontal and temporal language areas, including Broca's area, while listening to speech. These individuals also showed increased activity, along with a greater degree of activity between neuronal systems between Broca's area and Wernicke's area, while listening to the singing stimuli in comparison to control subjects (Lai, 2011,).

During the second portion of the study using DTI, the subjects with autism and the controls had nearly the exact same amounts of activity within their neural connections between the posterior and frontal brain regions. The only difference found was a slight decrease in activity within the left hemispheric connections in the subjects with autism during the speech condition. During the singing condition, the decreased activation within the left hemisphere returned to typical levels. These results imply that the connection in the left hemisphere of the subjects with autism is capable of transmitting speech information from the anterior language cortices to the posterior cortices, and that the connections do not seem to function as optimally as in the controls. These results also suggest specialization within the language circuits for singing rather than for speech in individuals with autism (Lai, Pantazatos, Schneider, & Hirsch, 2012; Lai, 2011). "The finding that song most reliably engages canonical language and music processing systems also lends credence for the use of music in the treatment of language disabilities in autism" (Lai, 2011, pg. 133).

It is commonly accepted that when an individual performs a particular behavior resulting in a pleasurable response, the pleasurable response is triggered by increased dopamine levels within the brain. It is also generally accepted that the pleasurable response increases the likelihood that an individual will continue the particular behavior in order to repeatedly experience this reward. Emanuele et al. (2010) analyzed the dopamine levels in the brains of individuals with ASD interested in music, musicians, and non-musicians with no interest in any aspect of music after a musical experience. Analysis of Varience (ANOVA) results indicated increased DRD4 mRNA levels in the brains of the participants with ASD and in the musicians, but not in the non-musicians with no interst in music. These results indicate that an interest in music could contribute to increased dopamine levels in the brains of individuals intersted in music resulting in a pleasurable reward response. These results further suggest that the increase in dopamine levels after music may possibly contribute to the the innate musical abilities of individuals with autism. Thus, the results provide perliminary evidence supporting the use of music in increasing and/or improving desired behaviors and responses, such as improved receptive language abilities, in individuals with autism (Emanuele et al., 2010).

Evidence of Music Therapy in the Treatment of Autism

Music therapy is not a new concept in the treatment of social communication deficits in individuals with Autistic Disorder. Rimland conducted a study with over 30 children diagnosed with autism in 1964. Results revealed that only one of the children did not show a preference for music. Rimland concluded that innate musical ability and preference for musical stimuli are consistent characteristics across populations with autism (Rimland, 1964). In the book *Music in Therapy,* Gaston compiled various accounts of the positive effects of using music-based interventions with individuals with autism. He noted that before music therapy treatment, parents of individuals with Autistic Disorder reported decreased responsiveness to other individuals within their surroundings (Gaston, 1968). However, after music therapy treatment, the children had begun to increasingly attend to others. Even though it is currently understood that autism is a spectrum disorder and not all individuals with autism are exactly the same, these results do show documentation of the previous use of music in therapy for individuals with autism.

Since the 1960s, a number of studies have been published regarding the use of music therapy with individuals with ASD. Results have suggested that children with autism exhibit an overall unusual ability to process music and engage in musical behaviors (Thaut, 1988). In 1994, Aldridge stated, " Music Therapy is accepted as a valid therapeutic treatment for children…" in hospital settings (Aldridge, 1994). Studies using music therapy assessment tools have exhibited the ability to assess strengths and weaknesses of individuals with autism related to the social and communication domains (Wigram, 2000). In a meta-analysis conducted in 2004 detailing the treatment effects of music therapy with children with autism, all resulting measured effects were positive, indicating the benefit of using music based interventions with this population (Kaplan & Steele, 2005; Whipple, 2004). Another meta-analysis by Gold, Voracek, and Wigram in 2004 determined that music therapy correlated with better therapeutic effects for individuals with behavioral and developmental disorders. Gold et al. (2006) meta-analysis results indicated that music therapy was statistically significant in increasing and improving verbal and nonverbal communication skills in comparison to the placebo therapies in the studies (Gold et al., 2006; Gold, Voracek, & Wigram, 2004). These results support the proposition that music could potentially improve the receptive language abilities of individuals with ASD.

Boso, Emanuele, Minazzi, Abbmonte, and Politi conducted a pilot study in 2007. The purpose of the study was to determine if consistent music therapy interventions across 52 weeks would positively affect the musical and nonmusical behaviors of 8 adults with low functioning ASD. The researchers utilized three different scales to determine the therapeutic affects after the training. The Clinical Global Impressions-Severity (CGI-S) scale assessed autism behaviors at the beginning of the study, and the Clinical Global Impressions-Improvement (CGI-I) scale assessed the participants' behavioral improvements throughout the study. The Brief Psychiatric Rating Scale (BPRS) assessed the severity of autism behaviors such as physical agitation, atypical conduct, and a lack of social contact between the participants and other people within their surrounding environment. Results indicated a statistically significant increase in the ratings of the participants after the treatment (Boso, Emanuele, Minazzi, Abbamonte, & Politi, 2007). Kim, Wigram, and Gold reported similar findings with children in 2009. They noted a greater amount of reciprocal responses during the music therapy sessions than during the nonmusical sessions with children with autism (Kim, Wigram, & Gold, 2009). This evidence supports the use of music therapy in treating the behavioral and social deficits associated with low functioning autism.

Gross, Linden, and Ostermann developed a pilot study in 2010 examining the use of music therapy in the treatment of children with speech delay. The characteristics of speech delay and the language deficits of autism are very similar. Results indicated that speech comprehension and phonological ability increased after music therapy treatment (Gross, Linden, & Ostermann, 2010; Lim, 2010a). Deficits in speech comprehension are a sign of receptive language disorders. This suggests that music therapy could be used to target deficits in receptive language.

Simpson and Keen (2011) examined the literature detailing the use of music to treat communication, socialization, and behavior deficits of children with autism. Previous studies have indicated that musical interventions have improved the social and communication deficits in individuals with autism (Accordino, Comer, & Heller, 2007; C Gold et al., 2006; Kaplan & Steele, 2005; Wan, Demaine, et al., 2010; Whipple, 2004; Wigram & Gold, 2006). "The research established that music therapy exhibited a highly significant medium to large effect on outcomes" (Accordino et al., 2007, pg. 13). However, research was scarce, and the majority of the research utilized methods that did not always produce experimental results and lacked proof that the skills were generalized to other nonmusical environments. None-the-less, these results are noted to contribute to the body of literature surrounding music therapy (Accordino et al., 2007; Aldridge, 1994; Simpson & Keen, 2011).

In 2011, Gadberry conducted a study to fulfill the requirements for a graduate degree in music comparing the transition times in three preschool classrooms: one with live music transitions, one with recorded music transitions, and a third without any music. He observed the shortest transition times during the live music condition in a total of two out of the three classrooms. More interestingly, Gadberry found that the fewest redirections were required during the music condition in two out of the three classrooms (Gadberry, 2011).

Lastly, Lai, Pantazatos, Schneider, and Hirsch (2012) studied speech and song circuits in the brains of children with low functioning ASD in comparison to typical functioning children of the same age. During the study, neural circuits were traced and monitored while controls and children with low functioning autism passively listened to verbal and sung information using Functional Magnetic Resonance Imaging (fMRI) and Diffusion Tensor Imaging (DTI). Results showed that activation within the left inferior frontal gyrus (LIFG) in the subjects with autism decreased during the speech condition in comparison to the controls. In contrast, activation within the LIFG was greater for the children with ASD than the controls during the sung condition. Additionally, subjects with autism had a greater amount of blood flow between the LIFG and the left superior frontal gyrus (LSFG) than the controls had during the sung condition. Finally, the group with autism exhibited increased blood flow between frontal and posterior brain regions during the sung condition and the controls did not. The sung condition paralleled with increased activity within the LIFG in the subjects with autism but not the controls. These results postulate that the neural systems for speech were stimulated to a greater degree during the sung condition than during the speech condition in the group with ASD. "…these findings indicate that in autism, functional systems that process speech and song were more effectively engaged for song than for speech" (G. Lai, Pantazatos, Schneider, & Hirsch, 2012, pg. 961). If songs engage the speech circuits substantially greater than verbalization in children with autism, then it is possible that songs could be utilized during therapy to address the receptive communication deficits in this population.

Initial evidence for the use of music therapy in treating receptive language deficits shows promise. However, no one has studied the use of sung information versus verbal information with individuals with ASD. To date, no one has studied this concept with any population. The results of the above studies support researching the use of music therapy to improve the receptive communication abilities of individuals with ASD. Research is needed to determine its efficacy.

Studies support both behavioral deficits and neuronal abnormalities as a basis for explaining autistic traits, such as impairments in receptive communication and socialization. Following verbal directives involves both receptive language skills and social skills. The purpose of this study was to examine the effects of using sung and verbal directives with young adults with the primary diagnosis of ASD. After an extensive review of the published literaute relating to this subject, it is believed that no other study has been conducted researching the use of sung information in the treatment of receptive language deficits associated with ASD. The null hypothesis of this study predicted that there would be no statistically significant differences between the successful completion of sung directives and verbal directives with young adults with the primary diagnosis of autism.

CHAPTER 3: METHOD

Hypothesis

The aim of the current study was to investigate whether young adults with autism respond better to sung directives or verbal directives. The null hypothesis was that there would be no statistical differences between sung and spoken directives. The directional hypotheses were developed in order to thoroughly test the null hypothesis: (1) There would be a decrease in the amount of time needed to successfully complete sung directives; (2) there would be a decrease in the number of re-directives needed to complete the sung directives; and (3) there would be a decrease in the number of prompts needed to complete the sung directives.

Participants

After the Institutional Review Board for Colorado State University approved the study, flyers and word-of-mouth were utilized to recruit participants. The goal was to recruit, at most, six young adults between the ages of 14 and 22 with the primary diagnosis of ASD. After soliciting volunteers via flyer (see Appendix G) and word-of-mouth, any potential participants with assistive devices for physical impairments, such as walkers or wheelchairs, were excluded from the study to control for any discrepancies due to motor difficulties. It is commonly accepted that individuals with ASD often exhibit coordination deficits; therefore, deficits in coordination did not prevent a participant's involvement in the study. If any of the participants exhibited any deficits in coordination, it would have been noted on the data collection form (see Appendix A). Also, individuals diagnosed with autism often have secondary diagnoses such as Attention Deficit Hyperactivity Disorder (ADHD) or epilepsy (Autism Speaks Inc., 2012; National Autism Association, 2012; National Institutes of Health, 2012). To prevent confounds resulting from multiple intersecting disabilities, participants with a dual cognitive disability diagnosis (i.e., autism and Down syndrome) were excluded from the study. However, participants with the primary diagnosis of autism with or without secondary disparate disabilities (i.e. autism and ADHD) were included in the study. A total of three volunteer participants meeting the exclusion criteria participated in the study.

Lastly, the remaining three male volunteers were labeled Participant A, Participant B, and Participant C to ensure confidentiality, and then randomly assigned to each experimental group, described in more detail below. Consent forms explaining the study were given to the parents and/or guardians of all the participants in person by the researcher (see Appendix F). The participants received assent forms explaining the study in person by the researcher (see Appendix E). The consent forms allowed parents and/or guardians of the participants to give signed consent for the participants to take part in the study and to be videotaped for accurate data coding during the study. Lastly, the assent forms allowed the participants to give signed consent to take part in the study and to be videotaped for accurate data coding during the study.

Preparation

Before beginning the study, the researcher met with the parents and/or guardians of each participant separately at each participant's house to agree upon six days and times during a three week period (totaling three hours with each participant across the entire study) to conduct each study observation. At that time, the parents and/or guardians and the researcher developed eight directives that were utilized during the composition of the final eight directives. After meeting with all of the parents and/or guardians, and after compiling three separate lists containing eight directives, the researcher developed a final list of eight directives (see Appendix C). This final list contained the directives repeated the most among the lists developed during the parent/guardian meetings to ensure that the participants were able to manage the directives. This final list of eight directives was used with each participant. This means that all of the participants were sung or read the exact same directives in the exact same order to control for directive complexity. Also, during the parent/guardian meeting at each participant's house, the parents and/or guardians showed the researcher the room and/or rooms in which each study observation occurred. Because the directives involved a variety of tasks that involved the participant utilizing multiple rooms in his/her home, the researcher followed each participant with the video camera while he/she completed each sung or verbal directive.

Finally, different melody lines for the eight directives on the final list were composed (see Appendix D). Each melody line was written in the key of C (based on the natural intonation of speech and the vocal range of the researcher) and ended on the tonic (C) to give a sense of finality to each directive. These melody lines stayed constant throughout the study and did not change among the participants to control for melody complexity. Because the melody lines mimicked natural speech intonation and rhythm, they were very similar to one another. The researcher delivered the directives during each experimental observation either verbally or sung acapella.

Lastly, after the eight melody lines for the eight directives were developed, the researcher utilized a Casio CDP-100 electric keyboard, iPhone with version 6.0.1 operating system software, an Apple Voice Memo app, and a Peterson BodyBeat Sync metronome to record the melody line of each directive at 70 beats per minute. The pre-recorded melody for each directive was utilized by the researcher before each sung directive to control for pitch variation among the sung conditions for all of the participants.

Design

A multiple baseline across participants design was utilized during this study. Observation A represented the verbal observation and Observation B represented the sung observation (treatment). There were a total of six experimental observations for each participant across a three-week period: Each participant was observed two times a week for a total of three consecutive weeks. Each participant was randomly placed into a treatment group, and each treatment group contained one participant. As shown below, each participant received a different amount of treatment and the commencement of treatment was staggered as follows: Treatment Group 1: AABBBB; Treatment Group 2: AAABBB; and Treatment Group 3: AAAABB (Thomas, Nelson, & Silverman, 2011). If a participant missed more than one experimental observation within two consecutive weeks, he/she was removed from the study.

Each participant was randomly assigned to one of the previously stated treatment groups. The name of each participant was written on a two-inch by five-inch piece of paper and placed into a sealed bowl that was four and three-fourths inches in diameter and six and one-third inches deep. The researcher shook the sealed bowl and then drew names one by one to randomly assign each participant to a treatment group. Each treatment group contained one participant. The assigned treatment groups were coded on a randomized assignment record form (see Appendix B). The randomized assignment record form, the consent and assent forms, and the small pieces of paper utilized during the random assignment were the only papers with the participants' names on them. The tapes and digital video recordings were labeled by participant letter and observation number (i.e. Participant A/B/C, Observation 1/2/3/4/5/6), NOT by participant name. These papers along with the tapes and digital video recordings were and are kept in a locked desk in a locked office in the Center for Biomedical Research in Music at Colorado State

University's Center for the Performing Arts. After the federally mandated three years following the completion of the study, the tapes, all documents bearing the participants' names, and any forms related to the study will be destroyed. The videotapes were not and will not be used for any other research, educational pursuits, or training activities. They were used for the sole purpose of accurate data coding during this study and will be destroyed after the federally mandated 3 years.

Setting

The study was conducted individually in each participant's home. The parents and/or guardians of each participant were respectfully asked to remain out of the rooms utilized by the participant during each observation to prevent distraction or any additional help other than that designated within the study protocol. During each observation, eight directives were communicated. The same directives were implemented during both the sung and spoken conditions for each participant. Each participant was sung or spoken the exact same directives. Each session was videotaped and later analyzed for accurate data coding (see Appendix A).

After setting up materials, the researcher asked the parent and/or guardian to bring the participant into the room and then leave. Upon the participant entering the room, the researcher began videotaping the research observation. Next, the researcher communicated the series of eight sung or spoken directives. The only auditory information used during the sung condition was the pre-developed melody lines sung acapella by the researcher. If any auditory directives needed to be repeated during the sung conditions, the corresponding melody line was utilized for each auditory re-directive during each sung condition with each participant. Therefore, all auditory information during all of the sung conditions was sung from the researcher to the participant. No verbal information was utilized during the sung conditions. Prompts were utilized depending on the needs of each participant. Prompts are discussed in detail in the section describing data collection. To ensure that the exact same pitches were utilized during all of the sung conditions with all of the participants, the researcher listened to the pre-recorded melody line of each directive on her iPhone before communicating each directive. The researcher wore one ear-bud headphone that was connected to the iPhone to prevent the subject from hearing the starting pitches before the researcher sang each directive. This took no more than 20 minutes. Also, the researcher wore the ear-bud headphone and carried the following to each experimental observation regardless of whether the directives were verbal or sung: her iPhone, a list of the eight directives on a three-by-five inches index card, and a video camera. This ensured that absolutely nothing differed between the sung and spoken experimental observations other than the auditory form in which the directives were communicated.

Upon completing the experimental observation, the researcher turned off the video camera, brought the participant to his/her parent and/or guardian, and confirmed the date and time of the next scheduled experimental observation. Finally, the researcher packed up the video camera and materials, and left the participant’s home. This entire sequence was repeated for each experimental observation with each of the research participants until all experimental observations were completed.

Data Collection

After all of the experimental observations were completed with all of the participants, the researcher and her research assistant separately coded each videotaped experimental observation on the data collection form for each participant (Appendix A). The individual time utilized by each participant to successfully complete an auditory directive was coded. The successful completion of a directive involved the participant completing the directive in its entirety. For example, if the participant was to bring a chair to the carpet, the directive was not successfully completed until he/she had gone to the chairs, picked up one chair, and had carried the chair to the carpet.

Also, the number of auditory re-directives, physical prompts, and/or gestural prompts was coded for each individual participant (see Appendix A). First, re-directives were defined as any type of verbal or sung prompt that re-directed the participant to the desired task. This included repeated directives. Second, physical prompts were any type of touch (elbow, arm, shoulder, or back tap) by the researcher to the participant to help the participant successfully complete a directive. Hand over hand assistance was not utilized, and an exact protocol for prompts was followed and is described below. Finally, a gestural prompt included any hand motions, body movements, or eye gazes that either got a participant back on track or helped a participant stay on task in order to successfully complete a directive.

In order to ensure consistency, the researcher followed an exact protocol when communicating the directive and when utilizing re-directives, physical prompts, and/or gestural prompts. After the first auditory directive, the researcher waited up to 10 seconds before repeating the directive. If the task was not completed, the researcher repeated the directive, waited an additional 10 seconds, and used a hand gesture or eye-contact to direct the participant to the desired task. If the participant needed an additional cue after waiting an additional 10 seconds, the researcher physically prompted the participant by tapping his/her arm or shoulder to direct him/her to the desired task. After waiting an additional 10 seconds, if the task was not completed after the initial sequence of re-directives and prompts, the entire sequence was repeated no more than two additional times (the sequence was done up to a total of 3 times with each of the eight auditory directives). If after the third sequence the auditory directive had not been completed, the researcher noted that auditory directive as incomplete and then moved on to the next auditory directive. No hand over hand assistance was utilized. This entire protocol was repeated with each auditory directive for each subject. The entire protocol was later coded on the data collection form and measured. (see Appendix A).

Additional Materials

Some complications were encountered after videotaping three experimental observations. First, one of the MP analog video tapes broke before the researcher and research assistant could watch and code one of the videotaped experimental observations. The researcher called the affected participant and his/her parents and/or guardians, explained the situation, scheduled a time to re-record, and then re-recorded the first experimental observation.

Next, the Hitachi 8mm Video Camcorder VM-E635LA analog video camera malfunctioned after taping two more experimental observations on a working MP analog video tape and was no longer useable. The remaining 16 experimental observations were digitally recorded utilizing a Bloggie HD Digital Video recording device. Those 16 digitally recorded experimental observations were downloaded from the digital camera to a USB PNY 16 Gigabyte memory drive using Bloggie software on a Toshiba laptop with a Windows Vista operating system. After transferring the digital videos from the Bloggie digital camera to the USB memory drive, the digital experimental observations on the Bloggie digital camera were permanently deleted.

Because the Hitachi 8mm Video Camcorder no longer functioned, the two working analog video-taped experimental observations were converted to digital video using the following materials: a Sony Digital HandyCam DCR-TRV470 NTS analog video camera, Mac Pro desktop computer with Snow Leopard operating system and attached Fire Wire port, Fire Wire 400 cable cord, and Apple iMovie software. The analog videotapes were first inserted into the Sony

Digital HandyCam. Then, the Sony Digital HandyCam was connected to the Mac Pro desktop Fire Wire ports via the Fire Wire 400 cable cord. Next, the Apple iMovie software was opened on the Mac Pro desktop. Once the Sony Digital HandyCam was turned on, the iMovie software detected the camera and converted the two experimental observation analog videos to digital videos. Once the analog videos were converted to digital videos, they were transferred onto the USB memory drive along with the other digitally recorded experimental observations. The researcher and her research assistant later watched the digital recordings on the USB memory drive and coded data on the data collection form (see Appendix A). The clock on the recordings was utilized by each coder to determine the amount of time it took each participant to complete each auditory directive. Because the clock on the videos measured time in minutes and seconds, the data coded on the data collection form was the time in seconds to complete each auditory directive.

CHAPTER 4: RESULTS

Statistics

This chapter presents the raw data and examines the results from the current study. This study employed a multiple baseline across participants and repeated measures design. Before data collection, Power was determined as follows: Alpha=0.05 and Beta=0.95; therefore p would need to be less than 0.05 for statistical significance to exist ($\alpha = 0.05$ and $\beta = 0.95; p < 0.05$). The dependent variable was the amount of time to complete each directive. Since auditory re-directives and gestural prompts were utilized one time during one experimental observation for one participant, and no other prompts were utilized throughout the entire study, prompting did not affect the successful completion of auditory directives by the volunteer participants. Therefore, the only independent variable pertinent to this analysis was the auditory directive, presented either verbally or sung.

Data was coded separately by the researcher and the research assistant. Inter-rater correlation between the researcher and the research assistant was measured using Pearson Product Moment Correlation (Pearson's r). This statistical test measures the correlation between two variables or coders when the measurement scale is continuous and has an absolute zero. The correlation can either be positive or negative, meaning the two variables positively correlate to one another or they have an inverse relationship (Archambault, 2000; Stemler, 2004). Gadberry used Pearson's r to test inter-rater agreement in his 2011 study on the effect of music on transition time and spoken redirections with elementary classrooms (Gadberry, 2011). Pearson's r was utilized to test inter-rater agreement in the present study since there were two coders, the measurement scale in this study was time which has an absolute zero and is continuous, and a similar study also used Pearson's r to test inter-rater agreement. Pearson's r was calculated using Statistical Package for the Social Sciences (SPSS) software (IBM Corporation, 2012). Correlation was significant at the level of 0.01 for a 1-tailed test and yielded a Pearson's $r = +\ 0.997$. This number is very close to + 1 and therefore, the two coders correlated with one another positively. Since, the two coders positively correlated with one another, each coder's raw scores were averaged together and then further analyzed using statistical measures. The averaged raw scores for each coder are presented in the below table:

Table 4.1: Raw Averaged Data

Averaged Data for Treatment Groups 1-3: Participants A-B												
A=Verbal; B=Sung; Data=Time (seconds)												
Treatment Group:	**Participant:**	**Day:**	**Condition:**	**Directive 1:**	**Directive 2:**	**Directive 3:**	**Directive 4:**	**Directive 5:**	**Directive 6:**	**Directive 7:**	**Directive 8:**	**Total Time:**
1	C	1	A	6.5	6.5	23	7.5	8.5	36.5	1.5	12.5	102.5
		2	A	10	2.5	22	4	7	18.5	2	9	75
		3	B	6	1	22	4	10.5	19.5	1.5	7.5	72
		4	B	12	4	29	4	6	13	3.5	1	72.5
		5	B	5	2.5	25	6	6.5	17	1	6.5	69.5
		6	B	7	4.5	33.5	2.5	6	13	2	2.5	71
2	A	1	A	5.5	3.5	58.5	6	14.5	11.5	1.5	5	106
		2	A	8.5	4	14.5	3.5	9	10.5	2.5	2.5	55
		3	A	6	3	15	5	8.5	6.5	1	2.5	47.5
		4	B	10.5	6	18	10	11.5	10	4	1.5	71.5
		5	B	13	4.5	16	4.5	11	9.5	3	2	63.5
		6	B	9	2.5	14.5	2	9.5	4.5	1	3	46
3	B	1	A	16.5	13	23	16.5	16.5	8	1	12	106.5
		2	A	14	8	22.5	11	15	6.5	1	14	92
		3	A	11.5	16.5	22.5	7.5	13.5	8.5	1	9.5	90.5
		4	A	13.5	9.5	22	8	13	8.5	1	8.5	84
		5	B	11	11	22.5	9	15	5.5	1	10	85
		6	B	16	18	23	7.5	14	5	1	9	93.5

Table 4.2: Raw Averaged Total Time in Seconds for Each Condition

Averaged Data for Treatment Groups 1-3: Participants A-B				
A=Verbal; B=Sung; Data=Time (seconds)				
Treatment Group:	**Participant:**	**Day:**	**Condition:**	**Total Time:**
1	C	1	A	102.5
		2	A	75
		3	B	72
		4	B	72.5
		5	B	69.5
		6	B	71
2	A	1	A	106
		2	A	55
		3	A	47.5
		4	B	71.5
		5	B	63.5
		6	B	46
3	B	1	A	106.5
		2	A	92
		3	A	90.5
		4	A	84
		5	B	85
		6	B	93.5

Once all of the data had been averaged, it was further analyzed utilizing a Repeated Measures Analysis of Variance (RM ANOVA) through SAS statistical software (SAS Institutue Inc., 2011). A RM ANOVA was used due to the repeated measures for each participant, and due to the fixed and random effects present throughout the present study (Thomas et al., 2011). The RM ANOVA produced the following fixed effects results:

Table 4.3: Type 3 Tests of Fixed Effects from RM ANOVA

One tailed test.

Effect	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Condition	1	128	2.06	0.0769
Directive	7	126	25.96	< 0.0001
Directive & Condition	7	126	0.25	0.9699

Effects:
Condition (day)-Fixed
Treatment Group-Random
8 Directives-Fixed

Results

The *p* value set for the study was $p < 0.05$. The *p* value of the statistic was $p = 0.0769$ for the condition effect. None of the results from the present study were statistically significant. However, the *p* value of the statistic was very close to the *p* value set for the present study. The *p* value for the directive affect equaled $p < 0.0001$ signifying that the directives were consistent among the participants. Lastly, the combined directive and condition effect was $p = 0.9699$ showing that there was low variance amongst the directives. Since, the directives were consistent throughout the study, there was very low variance amongst directives, and the condition effect (the *p* value of the statistic) was 0.0769 which was very close to the original *p* value of $p < 0.05$, the lack of statistical significance could have been due to low power and a small sample size.

Participant A averaged a total of 69.5 seconds for the verbal observations (A) and 60.33 seconds for the sung observations (B). An average of 93.25 seconds for the verbal conditions and 89.25 seconds for the sung conditions was seen throughout the observations with Participant B. Participant C decreased from an average of 88.75 seconds during the verbal observations to an average of 71.25 seconds during the sung observations. A power analysis was performed using Lenth's online power calculator based on a one tailed test for comparing verbal versus sung conditions (Lenth, 2009). Using the average and standard of deviation of the differences for the 3 participants in this study (average = 10.2 seconds, standard deviation = 6.8seconds) with n = 7 participants, the power for a one sided alternative would be 0.97 using alpha=0.05. If 7 volunteer participants were recruited and an average of 10.2 seconds with a standard deviation of 6.8 seconds remained constant, statistical significance could be reached detecting a difference between conditions A (verbal) and B (sung) given that there is a difference.

Lastly, data was plotted on graphs for visual observation of data over time between the sung and spoken conditions for each experimental observation. There was an overall decrease in time between the sung and spoken conditions. The below scatter plot and bar charts illustrate data over time:

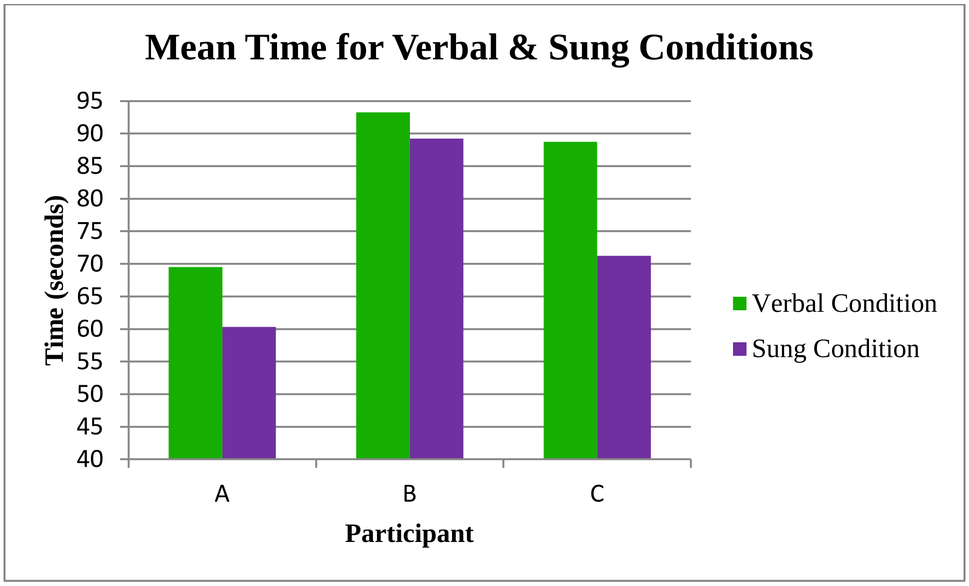

Figure 4.1: Total Mean Time for Verbal and Sung Conditions

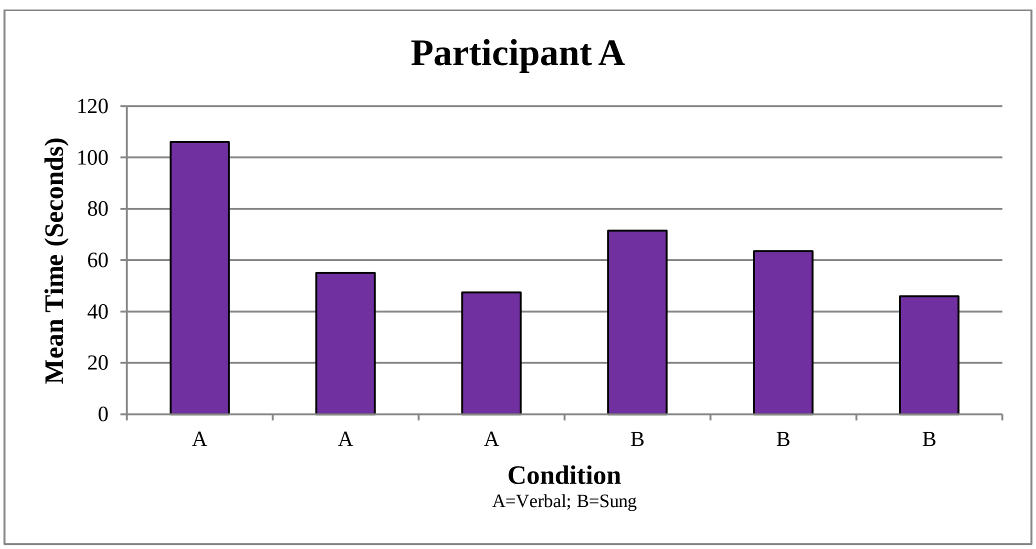

Figure 4.2: Participant A Total Directive Time Across Observations

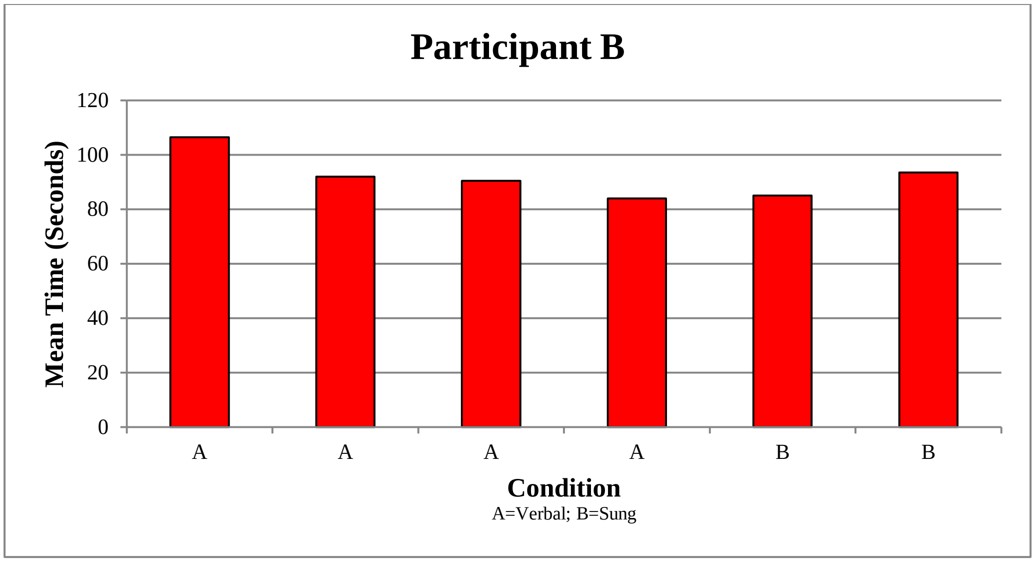

Figure 4.3: Participant B Total Directive Time Across Observations

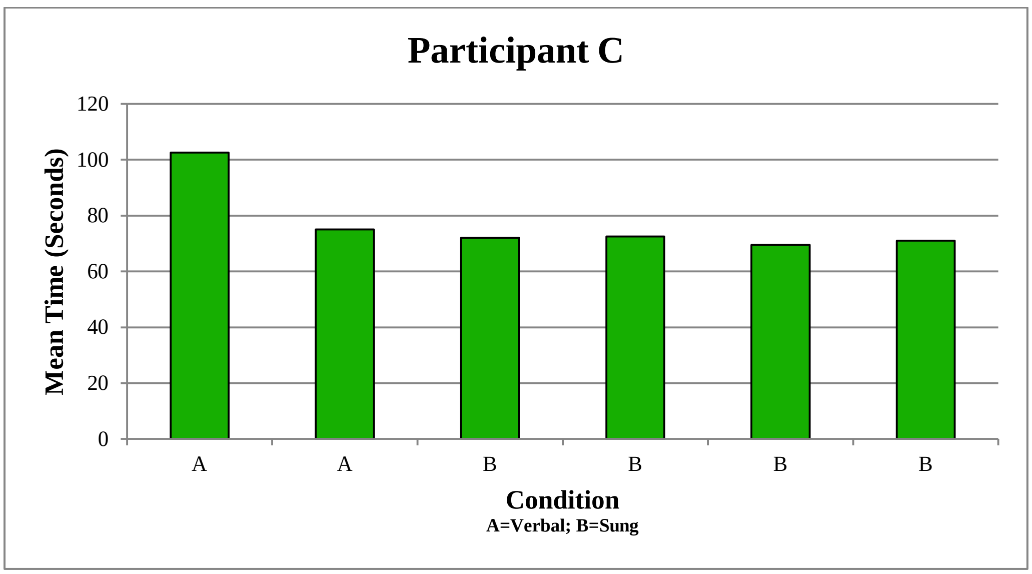

Figure 4.4: Participant A Total Directive Time Across Observations

The results indicated that there was an overall decrease in the amount of time to complete the sung directives, which was congruent with the researcher's predictions. However, after separating and plotting data on bar and line graphs, the trends are not clear and variability amongst the participants' times is presented. *Figure 4.5: Total Directive Time Across Observations* illustrates this variability.

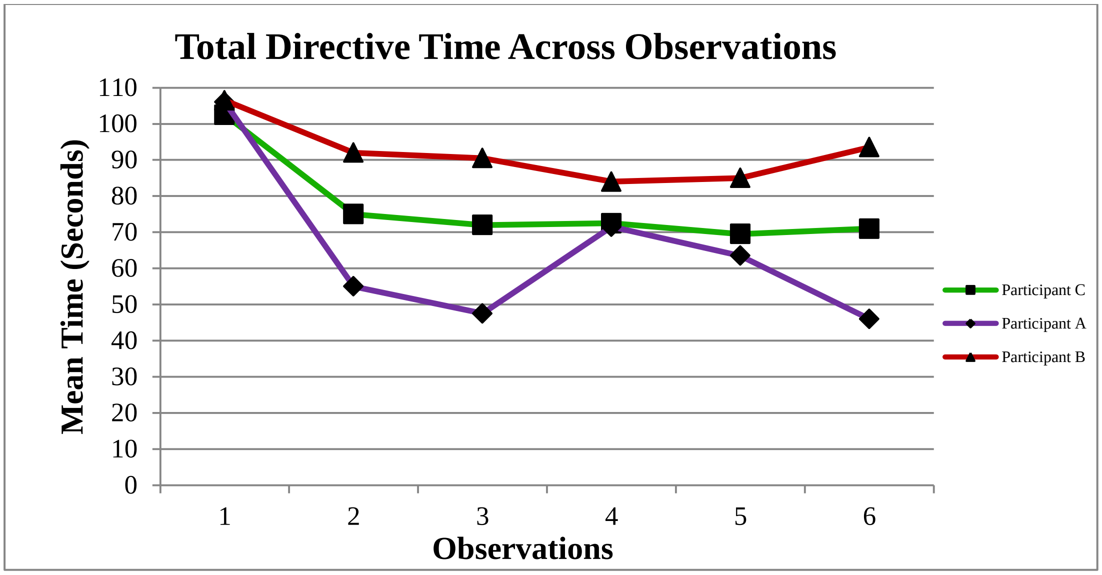

Figure 4.5: Total Directive Time Across Observations

All of the participants took the longest time completing directives the first day. Participant A's and B's times increased between the transitions from verbal to sung directives, while participant C's times decreased. The trends during the sung observations were not consistent amongst the participants and are not clear. There is not a big enough decrease in the total amount of time to conclude that the participants performed better in the sung conditions. A variety of factors could have contributed to the overall decrease in time seen between the verbal and sung conditions, and the variability seen in the averaged times across conditions between the participants. These contributing factors are detailed and discussed within the next chapter.

CHAPTER 5: DISCUSSION

The current study aspired to examine if young adults with Autism Spectrum Disorder could successfully complete sung directives in less time than verbal directives. Three volunteer participants were recruited and then randomly assigned to one of three treatment groups. Each individual received differing amounts of treatment (sung conditions). Each participant completed six experimental observations within a consecutive three-week period of time. Each experimental observation was videotaped and later coded on a data collection form (see Appendix A). The data was coded separately by the researcher and research assistant, and assessed the amount of time it took to complete a series of eight auditory directives during each experimental observation. The number of auditory re-directives, visual prompts, and physical prompts were also coded. However, one visual prompt and one physical prompt were utilized in the successful completion of one auditory directive by one participant. Due to the small number of re-directives and prompts, they were not included in the overall data analysis.

The information presented throughout the next section will expand on the data reported in the results chapter. The research within the literature review will resurface to thoroughly analyze the null hypothesis and the information presented in the results section. This section will conclude with clinical implications, limitations of the study, and suggestions for further research.

According to the American Psychiatric Association (2000) and the National Institute of Neurological Disorders and Stroke (2011), individuals with autism often exhibit difficulty in responding to their verbalized name, making eye-contact, and focusing on more than one aspect within the environment (American Psychiatric Association, 2000b; Autism Speaks Inc., 2011, 2012). The National Institutes of Health and the U.S. Department of Health and Human Services

(2012) define receptive communication disorder as an inability to understand verbal information, resulting in difficulties completing verbal directives and organizing logical thought patterns, and in deficits in language, socialization, and independent functioning (Hoch, 2012; National Institutes of Health, 2012). Individuals with autism often exhibit deficits in receptive language skills. All of the previously stated difficulties can affect the successful completion of verbal directives by people with ASD. Completing verbal directives is required in order to participate in society when performing a variety of tasks, including something as simple as ordering food at a restaurant. Until now, no study has researched the use of sung information versus verbal information to improve receptive language abilities in individuals with ASD or any other population with disabilities. The aim of the present study was to examine the use of verbal directives versus sung directives in the successful completion of auditory directives by individuals with autism.

Even though the use of music in the treatment of receptive language disorders has not been supported by research, using music in the treatment of communication deficits associated with autism is not a new concept. Gaston's 1968 study reported an increase in the attendance to others by children with autism after music therapy treatment (Gaston, 1968). An unusually superior ability to process music and engage in musical behaviors was reported by Thaut in 1988 (Thaut, 1988). A 2004 meta-analysis by Whipple looked at the treatment effects of music therapy on people with autism. All resulting measured affects were positive and indicated the benefits of using music therapy with individuals with ASD (Kaplan & Steele, 2005; Whipple, 2004). The fewest re-directives were observed during the musical transitions in two out of three pre-school classrooms in a study conducted by Gadberry in 2011 (Gadberry, 2011). Lai, Pantazatos, Schneider, and Hirsch studied speech and song circuits in low functioning individuals with ASD using fMRI and DTI in 2012. Results showed a decreased activation in the left inferior front gyrus (LIFG) during the spoken condition and increased activation in the LIFG during the sung condition. This was completely reversed in the control subjects. And it suggested that speech neural systems were more stimulated during the sung conditions than during the verbal conditions in individuals with autism (Lai et al., 2012). This could then suggest that singing may be better aurally received by individuals with low functioning autism. However research is needed to test this theory.

The null hypothesis of the current study predicted that there would be no statistically significant differences between the sung and spoken directive conditions. The researcher expected to see a decrease in the amount of time needed to successfully complete auditory directives during the sung conditions. After running a one tailed Repeated Measures of Analysis of Variance (RM ANOVA) on the repeated and random effects present throughout the study, no statistically significant results were found. However the p value of the statistic was $F(1, 7) = p < 0.0769$. The p value defined for this study was $p < 0.05$. Also the RM ANOVA revealed that there was very little variance amongst the directives (directive and combined condition effect of $Pr < F = 0.9699$) and the directives were consistent (directive effect of $Pr < F = <0.0001$) amongst the participants. This suggests that a lack of statistically significant results could have been related to a small sample size. Therefore, trends in the data will be discussed.

Results of previous studies detailed the innate musical abilities of individuals with autism, and music and language processing circuits in individuals with ASD. Järvinen-Pasley et al. studied perceptual speech processing (processing the musical aspects of speech) in individuals with ASD in 2008. The subjects with autism expressed superior abilities in processing prosody (pitch) but not semantics of verbal language. Actually, the subjects with autism exhibited difficulty developing meaning from spoken information, which is a symptom of receptive language disorders (Järvinen-Pasley et al., 2008; McCleery et al., 2010; C. Tesink et al., 2009). Also the subjects with ASD exhibited a superior ability to process the musical aspects of speech. This could be related to right hemispherical laterality for language processing in people with ASD (Järvinen-Pasley et al., 2008). Using this information, one could hypothesize that individuals with ASD would have an easier time completing sung directives than verbal directives.

In 2011, Lai conducted a study using DTI to examine the overlap between speech and music processing in the brains of individuals with ASD and controls. The subjects with ASD expressed decreased activity in their frontal and temporal language circuits during the spoken condition in comparison to the controls. However, activity within these same neurological areas increased during the sung conditions in comparison to the control group. This suggests that the brains of individuals with autism are possibly more specialized for singing rather than language (Lai et al., 2012; Lai, 2011). "The finding that song most reliably engages canonical language and music processing systems also lends credence for the use of music in the treatment of language disabilities in autism" (Lai, 2011, pg. 133)." If the brains of individuals with autism are more engaged by singing than verbal language, then logically less time would be needed to comprehend and complete sung directives.

Individuals with ASD often exhibit receptive language deficits including difficulty participating in school, home, and social situations, which may lead to problem behaviors. According to Hoch (2012) "This may include a hard time understanding what other people have said, problems following directions that are spoken to them or problems organizing thoughts" (Hoch, 2012; National Institutes of Health, 2012). Studies have reported that communication deficits in individuals with autism seemed to correlate with a decreased amount of neural activation in the Mirror Neuron System (MNS) of the brains of individuals with ASD (Fan et al., 2010). Both the language circuits of Broca's area and the left inferior frontal cortex are located within the MNS. Brown et al.'s 2004 study found that singing activates the frontal and temporal language circuits (all of which are present in the MNS) bilaterally to a greater degree than speech in autism. Then, perhaps singing could be used to improve receptive language skills and treat associated autism deficits (Brown et al., 2004).

When comparing all of the mean data sets in this study, overall there was a decrease in the amount of time to successfully complete the sung directives. This was congruent with the expectations of the researcher and the evidence presented throughout the Literature Review chapter. However after separating the verbal conditions from the sung conditions, this trend is not as clear and variability is seen amongst the participants. In fact a variety of factors could have contributed to the decrease in time between the verbal and sung conditions, and the differences seen in the averaged times between the participants. It is unknown if the decrease in time is due to the sung presentation of the directives or the other factors. The following is revealed after separating the verbal observations from the sung observations in *Figure 5.1* and *Figure 5.2:*

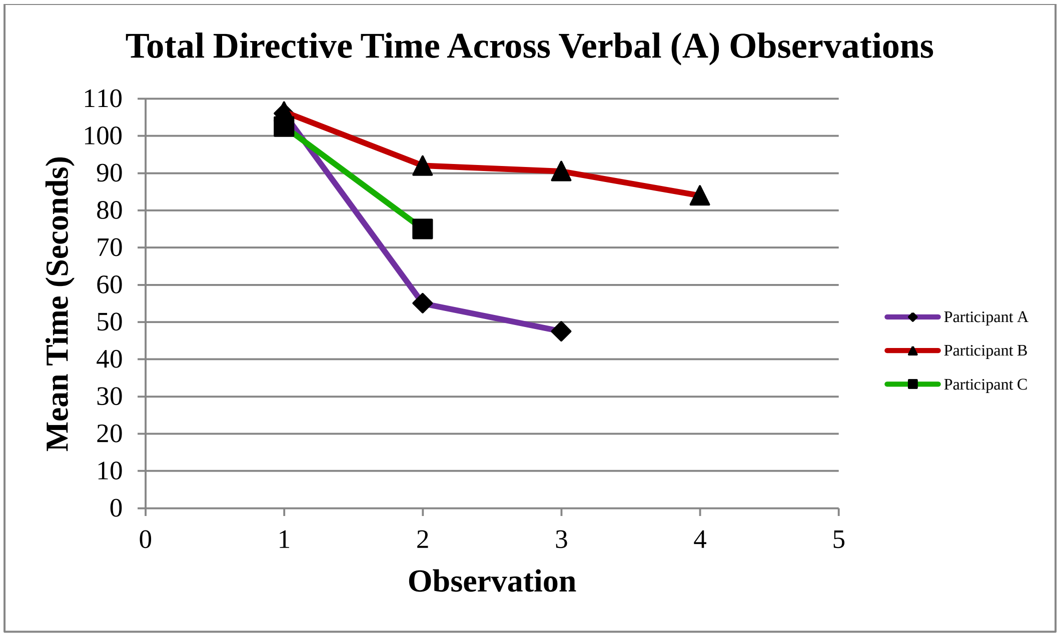

Figure 5.1: Total Directive Time Across Verbal (A) Observations

All of the participants spent the longest time performing directives on the first day and then continued to decrease as they most likely became more familiar with the auditory directives and the researcher (learning effects).

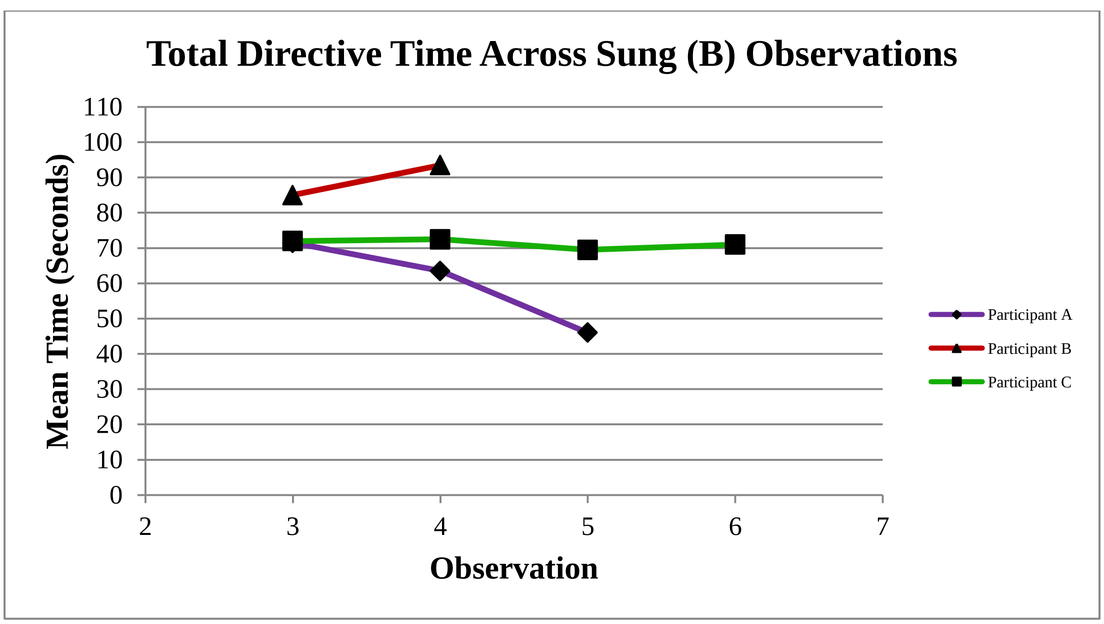

Figure 5.2: Total Directive Time Across Sung (B) Observations

Participant A's and B's times increased when transitioning from the verbal conditions to the sung conditions while Participant C's times decreased, and the trends during the sung observations were not consistent across the three participants. After the initial increase in time between the verbal and sung conditions, Participant A's mean times decreased throughout the remainder of the sung observations. Participant B's time continued to increase throughout his/her sung conditions and was completely the opposite of what the researcher had predicted. Participant C's mean times remained relatively constant throughout the sung observations. There is not a big enough decrease in the total amount of time to successfully complete directives between the verbal and sung observations, or a consistent decrease in time throughout the sung observations across the three participants to conclude that the participants performed better in the sung observations. The large amount of time each participant took to complete directives during the first verbal observation may have skewed the final results. Therefore the results are inconclusive. In the future other researchers may want to incorporate a period of time, one to two observations with each participant, where the exact protocol is completed but no data is recorded. This would control for skewed data resulting from novel tasks and routines, and/or people within the research subjects' environments.

Limitations of the Study: Suggestions for Future Research

The present study was limited in a number of ways. To start, volunteers for the study totaled three male participants within a 30 mile radius of Fort Collins, Colorado. All individuals diagnosed with autism exhibit deficits in socialization and communication, and display an intense resistance to change often accompanied by repetitive behaviors. However autism is a spectrum disorder and all of these characteristics are pretty broad. Also every individual with autism is vastly different from another individual with autism. All three participants in this study seemed to be higher functioning, meaning they were able to listen to and complete the auditory directives without any additional help such as re-directives or prompting during the sung and verbal conditions. None of the participants were female or seemed to exhibit any severe deficits, specifically receptive language deficits, or negative behaviors that are commonly seen from individuals with low functioning autism. Singing directives is not a technique therapists would use if their clients did not exhibit any receptive language deficits, or difficulties following and completing verbal directives. Because all the volunteer participants were male and seemed to be high functioning without deficits in receptive communication, no representatives were present from the female side and the low functioning side of the spectrum. Future studies should expand the sampling area and increase the sample size to recruit a more diverse sample population that represents the vast variety of functioning abilities present in the autistic population. This will potentially yield experimental results that can be applied to the entire population with autism and possibly inform clinical practices.

Even though the auditory directives were discussed before the start of the experimental observations and an exact protocol was followed throughout each experimental observation, multiple unforeseen events occurred throughout the study. The methods in which each participant successfully completed the auditory directives were not identical even though the directives for each participant were exactly the same. For example, the first auditory directive was "<Participant>, please hang up my jacket…" Participant A walked ten feet in order to hang up the researcher's jacket on a coat hook in the hall of his home. Participant B walked ten feet to place the researcher's jacket on a hanger and then hung up her jacket in the front entry closet. Participant C walked three feet to hang the jacket of the researcher on the back of a nearby chair. Each participant followed the directive correctly and successfully completed the directive.

However, each participant had a varying method for hanging up the researcher's jacket. When asked to turn on some music, some participants turned on a radio in the room they were in and others waited for a computer to boot up in another room in order to play music. Each method for each directive for each participant most likely took varying amounts of time, which could have affected the time to complete each auditory directive. This prevented the analysis of the successful completion of individual auditory directives across the three participants. Replication studies may want to try confining the study to one room of each participant's house or even pre-arranging lab space and having each participant report to the lab for each study observation. This would control for method variance among participants.

Next, the verbal directives were communicated at a rate that was natural to the researcher, and was more than 70 beats per minute. The melody lines of the sung directives were recorded on the researcher's iPhone at 70 beat per minutes. The researcher therefore communicated the sung directives at 70 beats per minutes. While watching the videotaped sessions, the researcher noticed that participant B moved at a slower cadence during the sung directives and a faster cadence during the verbal directives. Did the researcher's communication rate affect participant B's cadence while completing the auditory directives? Since the communication rate differed between the verbal and sung conditions, it is unknown if the sung directives decreased Participant B's cadence or were not as easily understood when completing tasks. Future researchers should say and sing the directives at the same rate to rule out rate of communication as a cause of decreased or increased time between the verbal and sung conditions.

When coding data, the researcher and research assistant utilized the clock on the digital recording in order to determine the amount of time it took each participant to complete each directive. Since, the clock showed time in minutes and seconds, the data coded was to the nearest second. However, at times it seemed that directives were completed by participants before the next second but after the previous second. A clock that reported time to the nearest millisecond would have been quite useful in these situations, and would have resulted in more accurate data coding. Replication studies should investigate ways to use more accurate clocks that report time to the nearest millisecond in order to yield more accurate results.

Lastly the order of the eight directives was kept constant for each observation and between each participant. Each participant heard the auditory directives in the exact same order each observation. Also, all of the verbal conditions preceded the sung conditions. This was meant to control for possible stress or negative behaviors resulting from a constant change in auditory directive routine. Instead this may have produced learning effects. The researcher and research assistant noticed that as the participants became more comfortable with the researcher and the directives, they began to anticipate the next directive in the sequence (gazing in the direction of the next auditory directive location within their home). In some cases, the participants even began to move in the direction of the next auditory directive location before or while the researcher was communicating the directive. Since, all of the verbal conditions preceded the sung conditions; it is difficult to determine if the decrease in the overall time to complete the sung directives was due to their sung presentation or the familiarity of the auditory directive routine (learning effect). Future studies should randomize the order of the eight directives each experimental observation, and randomize the condition order in each treatment group, to rule out routine familiarity as a possible factor in decreasing time between the spoken and sung conditions.

Clinical Implications

Because the present study yielded inconclusive results, due to a small sample size and inherent study design flaws, the direct cause in the decrease in time needed to complete sung directives discussed previously cannot be determined. However, the information presented in this thesis can be used as a basis for further research in this area. The literature review suggests that less time may be needed to complete sung directives versus verbal directives with young adults with autism. Board Certified Music Therapists, like Meredith Powers and Bridget Kulik (personal communication, April 25, 2012), working with individuals with ASD can use the research within the literature review, combined with the skills and abilities of each client, combined with the results they see within their music therapy sessions with each client, to support the use of sung directives with their clients with autism. This study, to the best of the researcher's knowledge, is the only experiment that has expressly examined the use of singing to help address receptive language deficits, specifically following auditory directives, with individuals with autism. The results of the present study are inconclusive. More research is needed to determine if the use of sung directives is successful with this population before informing clinical practices.

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APPENDIX A: DATA COLLECTION FORM

Treatment Group: 1 2 3 Study Observation:____ Condition: Sung / Spoken

DATA:

Directive # 1:____

-Time (seconds): _________

-Additional Help to Complete Directive:

	Time # 1:	Time #2:	Time #3:
Re-Directive:	_______	_______	_______
Gestural Prompt:	_______	_______	_______
Physical Prompt:	_______	_______	_______

-Total # of Re-directions: ________

-Total # of Prompts: Gestural: _______; Physical: _______;

Directive # 2:____

-Time (seconds): _________

-Additional Help to Complete Directive:

	Time # 1:	Time #2:	Time #3:
Re-Directive:	_______	_______	_______
Gestural Prompts:	_______	_______	_______
Physical Prompt:	_______	_______	_______

-Total # of Re-directions: ________

-Total # of Prompts: Gestural: _______; Physical: _______;

Directive # 3:____

-Time (seconds): _________

-Additional Help to Complete Directive:

	Time # 1:	Time #2:	Time #3:
Re-Directive:	_______	_______	_______
Gestural Prompts:	_______	_______	_______
Physical Prompt:	_______	_______	_______

-Total # of Re-directions: ________

-Total # of Prompts: Gestural: _______; Physical: _______;

Directive # 4:____

-Time (seconds): _________

-Additional Help to Complete Directive:

	Time # 1:	Time #2:	Time #3:
Re-Directive:	_______	_______	_______
Gestural Prompts:	_______	_______	_______
Physical Prompt:	_______	_______	_______

-Total # of Re-directions: ________

-Total # of Prompts: Gestural: _______; Physical: _______;

Directive # 5:____

-Time (seconds): _________

-Additional Help to Complete Directive:

	Time # 1:	Time #2:	Time #3:
Re-Directive:	_______	_______	_______
Gestural Prompts:	_______	_______	_______

Physical Prompt: _______ _______ _______

-Total # of Re-directions: ________

-Total # of Prompts: Gestural: _______; Physical: _______;

Directive # 6:____

-Time (seconds): _________

-Additional Help to Complete Directive:

	Time # 1:	Time #2:	Time #3:
Re-Directive:	_______	_______	_______
Gestural Prompts:	_______	_______	_______
Physical Prompt:	_______	_______	_______

-Total # of Re-directions: ________

-Total # of Prompts: Gestural: _______; Physical: _______;

Directive # 7:____

-Time (seconds): _________

-Additional Help to Complete Directive:

	Time # 1:	Time #2:	Time #3:
Re-Directive:	_______	_______	_______
Gestural Prompts:	_______	_______	_______
Physical Prompt:	_______	_______	_______

-Total # of Re-directions: ________

-Total # of Prompts: Gestural: _______; Physical: _______;

Directive # 8:____

-Time (seconds): _________

-Additional Help to Complete Directive:

	Time # 1:	Time #2:	Time #3:
Re-Directive:	_______	_______	_______
Gestural Prompts:	_______	_______	_______
Physical Prompt:	_______	_______	_______

-Total # of Re-directions: ________

-Total # of Prompts: Gestural: _______; Physical: _______;

Coordination Deficits: YES NO

If so, describe:

____

____

____

____

TOTALS (entire session):

Total Time: ________

Total Re-directions: ________

Total Prompts: Gestural: ________; Physical________

APPENDIX B: RANDOMIZED ASSIGNMENT RECORD

PARTICIPANT A: ____

PARTICIPANT B: ____

PARTICIPANT C: ____

<u>GROUP 1-AABBBB</u>: ____

<u>GROUP 2-AAABBB</u>: ____

<u>GROUP 3-AAAABB</u>: ____

APPENDIX C: VERBAL DIRECTIVES

1. <Participant’s name>, please hang up my jacket, thank you.
2. <Participant’s name>, please show me your calendar, thank you.
3. <Participant’s name>, please get me a glass of water, thank you.
4. <Participant’s name>, please show me a picture of your brother, thank you.
5. <Participant’s name>, please get me a tissue, thank you.
6. <Participant’s name>, please show me your favorite movie, thank you.
7. <Participant’s name>, please give me a high five, thank you.
8. <Participant’s name>, please turn on some music, thank you.

APPENDIX D: SUNG DIRECTIVES

Figure D.1: Sung Directives

APPENDIX E: ASSENT FORM

Colorado State University Application for Human Research Review: Participant Assent Form

Hi!

My name is Katrina and I am a graduate student at Colorado State University. I study music therapy, or the effects of music on everyday behaviors and functions. This is called <u>research</u>. My research is about how music would help young adults with autism function to the best of their ability every day. I am asking you if it is OK that I study you while you complete directions at home.

If you say it is OK, I'll ask you to meet with me 6 separate times and do a series of 8 directions. I will say or sing these same 8 directions each time I meet with you. I will ask you to perform actions like “standing up”, “sitting down”, and/or “clapping your hands three times”. There isn't a right or wrong action --- it is just about you listening to what I say or sing and then doing the action. Each meeting will last 30 minutes. I will videotape you acting out the directions during each meeting. Once you have acted out all 8 directions, I will pack up my supplies and go back to Colorado State University. After returning to Colorado State University, I will watch the video and fill out a worksheet to record the results of each direction during each meeting. Your name won't be on the worksheets or the videotape, so no one will know what you did.

Agreeing to be in this project cannot hurt you. It won't help you, either. You won't get any gift for doing it. You don't have to do it. If you say "yes" now but later change your mind, you can stop being in the research any time by just telling me.

I will ask your parents if it is OK that you do this, too. If you want to be in this research, sign your name and write today's date on the line below.

Participant Date

Researcher Date

APPENDIX F: CONSENT FORM

Consent to Participate in a Research Study
Colorado State University

TITLE OF STUDY: Sung Versus Verbal Directives with Young Adults Diagnosed with Autism

PRINCIPAL INVESTIGATOR: A. Blythe LaGasse, Ph.D., Assistant Professor, Department of Music, Blythe.Lagasse@colostate.edu

CO-PRINCIPAL INVESTIGATOR: Katrina Koszczuk, MT-BC, Music Therapy Master's Student Department of Music, Katrina.Koszczuk@colostate.edu

WHY IS MY CHILD BEING INVITED TO TAKE PART IN THIS RESEARCH? Your child is being asked to participate because he/she is between the ages of 14-22 with the primary diagnosis of Autism Spectrum Disorder.

WHO IS DOING THE STUDY? The study will be conducted by Katrina Koszczuk, a student pursuing a master's degree in Music Therapy, under the supervision of A. Blythe LaGasse.

WHAT IS THE PURPOSE OF THIS STUDY? The purpose of this study is to determine the effects of using sung versus verbal directives with young adults with the primary diagnosis of Autism Spectrum Disorder.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST? The study will take place in your home. The Principal Co-Investigator will come to your home to conduct the study. At total of 6 study observations will be conducted with your child across a three week period of time. Each study observation should last approximately 30 minutes. The time required to participate in the study should total approximately 3 hours across three consecutive weeks.

WHAT WILL MY CHILD BE ASKED TO DO? Your child will be asked to complete a series of 8 sung or verbal directives during each study observation at his/her home. Auditory re-directives, physical, and gesture prompts may be utilized by the co-principal investigator to help the participant stay on task and/or successfully complete each auditory directive.

ARE THERE REASONS WHY MY CHILD SHOULD NOT TAKE PART IN THIS STUDY? If your child has any motor limitations resulting in the use of a walker or wheel chair, or has a dual COGNITIVE disability diagnosis (i.e., Down syndrome and autism), he/she should not participate in this study.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?
There are no known risks associated with the procedures in this study. It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

ARE THERE ANY BENEFITS FROM TAKING PART IN THIS STUDY? There are no direct benefits to you or your child for participating in this study. However, we hope that your child's participation in this study will contribute to the current knowledge regarding the effect of sung information on the auditory comprehension skills of young adults with Autism Spectrum Disorder.

DOES MY CHILD HAVE TO TAKE PART IN THE STUDY? You and your child's participation in this research is voluntary. If you and your child decide to participate in this study, you and/or your child may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you and your child are otherwise entitled.

WHO WILL SEE THE INFORMATION THAT I GIVE? We will keep private all research records that identify you, to the extent allowed by law.
Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. Your child will not be identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private.

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. For example, your name will be kept separate from your research records and video recordings, and these two things will be stored in a locked desk in a locked office at Colorado State University. The principal investigator (Dr. Blythe LaGasse) and the principal co-investigator (Katrina Koszczuk) will be the only two people with access to all video recordings, forms, papers, and data. No other individuals will have access to any information relating to the above study.

Federal law mandates that all research data and consent forms be kept secure for a minimum of 3 years. Proceeding this 3 year period, all papers, videotapes, forms, and/or documents associated with the study will be destroyed. To clarify the videotapes will not be used for any other research, educational pursuits, or training activities. The videotapes will be used solely for accurate data coding during this project and then destroyed after the federally mandated three years.

You should know, however, that there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court OR to tell authorities if we believe you have abused a child, or you pose a danger to yourself or someone else.

CAN MY CHILD TAKING PART IN THE STUDY END EARLY? If your child misses more than one study observation across a two week period, he/she may be removed from the study.

WILL I RECEIVE ANY COMPENSATION FOR TAKING PART IN THIS STUDY? There is no compensation for taking part in this study.

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

WHAT IF MY CHILD OR I HAVE QUESTIONS? Before you and your child decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later if any questions should arise, you can contact the principal investigator, A. Blythe LaGasse at 970-491-4042 or blagasse@colostate.edu. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655. We will give you a copy of this consent form to take with you.

This consent form was approved by the CSU Institutional Review Board for the protection of human subjects in research on July 25, 2012.

WHAT ELSE DO I AND MY CHILD NEED TO KNOW? Each study observation will take place in your home, and will be videotaped for accurate data coding. Each participant will be placed into a different treatment group and each group's treatment amount will vary. This means that your child will receive an amount of treatment that is different from all other participants within the study.

Your signature acknowledges that you have read or been read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing 3 pages.

PARENTAL/GUARDIAN SIGNATURE FOR PARTICIPANT
Your signature acknowledges that you have read the information stated and willingly sign this consent/assent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing 3 pages.

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

____
Minor's date of birth

____
Parent/Guardian name (printed)

____________________________________ ____________________
Parent/Guardian signature Date

APPENDIX G: STUDY FLYEER

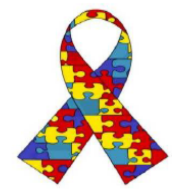
Colorado State University

VOLUNTEERS WANTED

~~~~~~~~~~~~Sung Versus Verbal Directives with Young Adults with Autism~~~~~~~~~~~~

STUDY: The purpose of this study is to determine the effects of using sung versus verbal directives with young adults ages 14-22 with the primary diagnosis of Autism Spectrum Disorder. The Co-Principal Investigator will come to your home to conduct the study. A total of 6-thirty minute study observations will be conducted with each participant across a three week period of time, totaling 3 hours. During each study observation, the participant will be asked to complete 8 sung or verbal directives.

INCLUSION CRITERIA: (1) Formal documentation of an Autism Spectrum Disorder; (2) Primary language of English; (3) No report of dual COGNITIVE disability diagnosis (i.e., autism and Down syndrome); (4) No motor limitations resulting in the use of a walker or wheelchair; and the (5) Ability to commit to six sessions across a consecutive three week period of time. Volunteers will not be excluded based on race, gender, or "level" of autism.



POTENTIAL BENEFITS: There are no direct benefits to any volunteers participating in this study. However the researcher hopes that the data gained throughout this study will contribute to the current knowledge regarding the effect of sung information on the auditory comprehension skills of young adults with autism.

CONTACT INFORMATION: This research is conducted under the direction of the Principal Investigator: A. Blythe LaGasse, Ph.D., Assistant Professor, Department of Music. To learn more about this research, call 970-491-4042 or send an e-mail to Blythe.Lagasse@colostate.edu.

Approved by the CSU IRB on 8/24/2012

Figure G.1: Study Flyer
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