EVALUATION OF THE EFFICACY AND PARENT PERCEPTIONS OF SONGS AS AN ARTICULATION EXERCISE

by

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ABSTRACT

MELISSA K. PHILLIPS. Evaluation of the efficacy and parent perceptions of songs as an articulation exercise. (Under the direction of DR. CYNTHIA BAUGHAN)

The purpose of this study was to examine the use of phonologically-rich choruses in speech therapy on the articulation accuracy of kindergarten through second grade children who demonstrate speech-sound errors. Specifically, this study consisted of providing students with traditional speech therapy until a baseline was achieved, then staggering the start times of the participants' musical interventions, teaching the participants an articulation song in therapy, and providing parents with the means and method of tracking usage. Identical assessments were taken pre- and post-intervention and identical cold probe data was taken biweekly at the beginning of each session to track the participants' progress accurately. A pre-intervention survey was given to the parents for informative purposes. A post-intervention survey was also given to the parents to examine the parent perceptions of songs as the articulation exercise. The results of the intervention indicated that the use of phonologically-rich choruses is an effective exercise to supplement speech therapy in kindergarten students. The parent responses in the follow-up survey indicated that they were interested in continuing to use the musical method as an at-home exercise.

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CHAPTER 1: INTRODUCTION

There are approximately 74.2 million children (under the age of 18) in the United States. Over 2 million of those children are five to seven years old and have been identified as having a speech sound disorder (Law, Boyle, Harris, Harkness, & Nye, 2000). By first grade, roughly 5% of children have noticeable speech errors (U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, 2012). Speech sound errors include inaccuracies in phonology and/or articulation. Phonology is the understanding and study of how sounds can be added together to create words, thoughts, and ideas. Articulation is the synchronization of air and articulators (i.e. tongue, mandible, velopharynx, and lips) to produce speech sounds. Errors of speech sounds occur, therefore, when the air and/or articulators are not producing sounds correctly. For example, a child might say "thithter" instead of "sister" or "bruder" instead of "brother."

As people listen to others speaking, they often form opinions and assumptions about the speaker in their minds, such as nationality, gender, and age. Typically, over 85% of school-based speech therapy is articulation therapy. A school-based speech-language pathologist's (SLP) main course of action for children with articulation disorders is (1) achieve stimulability of the target sound, (2) master the target sound at word and phrase level, (3) master the target sound at sentence and conversation level, and (4) dismiss or "graduate" the student from speech ideally before he/she reaches middle school. These steps are typically worked on incrementally in 15-30 minute sessions two

or three times a week with varying times and intensities based on the severity of the student's disorder or delay.

A benefit of relatively brief speech sessions is the ability to use the time as a form of activity-based intervention. Because individuals use speech in almost everything they do, SLPs are able to create a natural environment in which the student's target sounds are embedded. For example, sitting down and playing BINGO becomes an avenue to embed word drilling. Filling the speech room with toys, books, and activities that contain strategic target sounds becomes a spontaneous speech practice. Speech sessions are often supplemented by work sheets or word lists sent home with the student to be drilled by or with the parent. However, when word lists are taken home, activity-based intervention is replaced with drilling. Providing additional natural, spontaneous strategies for parents could allow for parents being more included in the development of their child.

Music has been a notable piece of almost every culture for centuries. It is a vital part of religions, customs, practices, and ways of life. Music's evolution serves as a timeline of history. Music has the power to reflect not only specific events and opinions of people groups through the lyrics of songs, but also the mood, worldview, opinions, values, and beliefs of people groups through the melodies and complexity of the notes chosen. Zoller (1991) described music as "a universal language, transcending all language barriers" (p. 272). Making music, like speaking, is a natural way for humans to express feelings and ideas. Music and speaking share other characteristics as well, such as rhythm, rate, prosody, diction, frequency, and range (Cohen, 1994).

Because music and language are so closely related in their expression and characteristics, past research has attempted to identify links in the brain between

language, music, and learning. Wan and Schlaug (2010) explained that the corpus callosum was significantly larger in children who began music lessons at a young age as compared to children who started music lessons later in life. The corpus callosum is the area of the brain where millions of axons conduct interhemispheric communication to facilitate motor, sensory, and cognitive performance between one side of the brain and the same region on the opposite side. It is believed that a larger corpus callosum is associated with higher intelligence and functioning.

Another link between language and music was found in the activation of Broca's area. Broca's area, located in the frontal lobe of the brain, is responsible for language processing and speech production. After reviewing past research, Wan and Schlaug (2010) reported that Functional Magnetic Resonance Imaging (fMRI) studies showed Broca's area activated during music perception tasks, singing tasks, and even instrument playing tasks. This activation of Broca's Area suggested that music and speaking share neural pathways and therefore strengthened their common network. Additional research examined plasticity as it related to children participating in musical training for over a year. Brain plasticity is the human brain's capacity to change, reorganize, and learn by creating new pathways in the brain. Areas of the children's brains that showed structural changes post-music training included the corpus callosum, precentral gyrus, and the Heschl gyrus (Hyde et al., 2009). The structural changes in these areas of the brain are vital in voluntary motor movement and auditory processing, therefore giving a child more control over the movement of his or her articulators and improving his or her ability to understand speech. According to Wan and Schlaug (2010) the plasticity of the young

brain learning music implies that multisensory interventions can be used in children to treat certain developmental disorders.

Due to the neural plasticity and shared pathways of speech and language in a child's brain, it is possible that singing as an articulation therapy may help improve communication of children who are communicatively-impaired (Cohen, 1994). Ogden (1982) examined singing as an articulation therapy in 43 school-aged children with interdental stigmatism (more commonly referred to as a lisp). He hypothesized that the pleasure of singing would encourage enjoyment in treatment and motivation to exercise their speech. Children who are not motivated to drill or train their brains and articulatory muscles to improve may lack the necessary drive to meet or exceed their articulation goals (Cohen, 1994). "By engaging the concentration and motor control of children musically, their attention can be directed away from the tediousness of articulation exercises (Ogden, 1982)" (as cited in Cohen, 9). His findings, contrary to his hypothesis, indicated that the traditional therapy and music-based therapy scores were not statistically significant.

1.1 Statement of Problem

The purpose of this study was to examine the use of phonologically-rich choruses in speech therapy on the articulation accuracy of kindergarten through second grade children with articulation disorders. The intent of this study was to determine whether or not the use of music as an articulation intervention will enhance the therapy process in children with articulation disorders. Specifically, are there significant increases in the student's intelligibility of target sounds as measured by pre- to post-intervention

screenings? An additional intention of this study was to provide parents with an effective, user-friendly means of implementing "speech homework" with their child.

1.2 Research Questions

The aim of this study was to formulate and administer effective, phonologically-rich choruses to be used in therapy sessions as well as at home for kindergarten through second grade children with articulation disorders. Through parent perceptions, pre- and post-intervention screenings, and therapist logs, this study answered the following questions: A) Are phonologically-rich songs, taught in speech therapy and practiced in the speech session and at home with the parent/guardian, an effective exercise to supplement therapy in kindergarten through second grade children with articulation disorders? B) What are the parent's/guardian's perceptions of using singing as a take-home, guided exercise?

CHAPTER 2: REVIEW OF THE LITERATURE

To identify relevant literature on songs as an articulation exercise, the following EBSCOhost research databases were searched: PsycINFO, PubMed, and ERIC. The terms *speech therapy, speech disorders, articulation, language, cognition, corpus callosum, music, music therapy,* and *activity based* were used in the electronic search. In addition, books regarding theories of childhood and normal language development were explored to locate further resources for the literature review. Based on these searches, the following theories and studies were found relevant to the study of songs as an articulation exercise.

2.1 Theoretical Framework

Feuerstein et al. (2006) proposed a framework that used music to influence a child's cognitive modifiability. The theory of cognitive modifiability supports the idea that the presentation of lessons through an untraditional medium will motivate students through the arduous tasks of rote memorization or therapy. Mediated learning experiences are experiences presented to a child wherein they learn about the circumstances around them through a medium. Vygotsky believed that this medium was best served by special tools given to children (Mooney, 2013). Feuerstein, however, believed that this medium was best facilitated by other humans who are equipped with those special tools or untraditional, novel methods of instruction. It was the opinion of Feuerstein et al. (2006) that learning experiences can also be mediated by a child's own self-regulation, voluntary attention, and logical memory. Based on Feuerstein's theory of mediated learning experiences, children can be motivated to learn when presented with an untraditional teaching style (i.e. music). Children are also capable, according to Feuerstein's theory of cognitive modifiability, to modify their neural pathways similar to what is necessary for successful articulation therapy.

2.2 Music Lessons and School Related Opportunities

Portowitz, Peppler, and Downton (2014) studied using technology-based music education to enhance general learning skills through a program called "In Harmony." The "In Harmony" method drew on Feuerstein's theory regarding structural cognitive modifiability and mediated learning experience (Feuerstein, Feuerstein, Falik, & Rand, 2006; Feuerstein, Rand, & Rynders, 1988) as well as Klein's More Intelligent and Sensitive Child pedagogical approach (Klein, 1996). This method provided a context wherein students could demonstrate their skills in working memory, self-regulation, and cognitive flexibility. The question that this study addressed was "Will children who participate in the 'In Harmony' program significantly improve their working memory, self-regulation, and cognitive flexibility" (Portowitz et al., 249). "In Harmony" was implemented with nine and ten year old children in school settings in Tel Aviv, Israel. The children were divided into an experimental group of 40 children and a control group of 22 children. The experimental and control groups were both matched in age, socioeconomic status, and school setting. Computers equipped with the "In Harmony" software were available during the music training sessions. Over four months, students in the experimental group received two hours of music training per week, totaling 32 hours over the duration of the program. The first of two 50-minute lessons was done individually with the computer software. The second lesson was a structured group lesson that focused on sharing ideas, performing, and reflecting. After the courses were completed, the children reconstructed and composed melodies and tunes based on the lessons they had learned. The children in the control group continued in their regular education and studies but were not given the "In Harmony" training and instruction.

Working memory, self-regulation, and cognitive flexibility were measured pre- and post-intervention in both the experimental and control groups. Working memory was measured quantitatively with a complex figure test of copying and memory. Musical understanding was measured qualitatively by a drawing task, which also provided information concerning working memory and cognitive flexibility. To measure the final category cognitive flexibility, researchers measured the rationale logs that the children kept during the study to explain their compositional choices. The results indicated a significant improvement in working memory, self-regulation, and cognitive flexibility post-intervention in the experimental group. The control group post-intervention scores indicated no improvement and even a slight decline. The study suggests that the "In Harmony" program does provide an effective platform where children of varied socioeconomic and cultural backgrounds can build working memory, visual memory, and cognitive flexibility.

Kaviana, Mirbaha, Pournaseh, and Sagan (2014) investigated the impact of music on cognitive development as well, but in preschool children. Sixty children between the ages of five and six years old were divided randomly between two groups, one group receiving music lessons and the other receiving no music lessons. All children were pre-tested before the start of the lessons and were given four subtest post-tests. Findings indicate that the children who received music lessons scored significantly higher on verbal reasoning and short-term memory subtests than the children who did not receive music lessons. The numerical and visual/abstract memory subtest scores, however, were not significantly different between the experimental and control groups.

While Portowitz, Peppler, Downton (2014) and Kaviana, Mirbaha, Pournaseh, Sagan (2014) focused on general learning skills, other programs pinpointed the use of music in changing the lives of students. Hallam, Creech, and McQueen (2016) studied whether or not the Musical Futures program improved students' team work, motivation, self-esteem, concentration, organization, and attitudes towards learning by interviewing the perceptions of teachers and staff at participating schools. Musical Futures is a learning program based around music to provide children a musical way to pursue education and interests while strengthening their knowledge of music. The program prides itself on being student-centered, student-driven, and teacher-facilitated. A mixed-methods research design was carried out in three phases over a three year period. Seven different secondary Musical Futures Champion schools with students ranging in age from 11-18 years participated in this research. Likert-scaled questionnaires were administered to each school once in all three phases of the research. Responses came from a wide range of non-music staff in order to gauge how well Musical Futures affected the students' team work, motivation, self-esteem, concentration, organization, and attitudes towards learning. Non-music staff respondents included individuals representing subject department heads, head teachers, senior management team members, library staff, technicians, and pastoral staff. During Phase 1 and Phase 2, while the Musical Futures program was being implemented, teachers and staff from all participating schools completed questionnaires regarding the positive impact of the program on the whole school. The first two phases received various positive and negative feedback. By Phase 3 of the study, however, there were no negative responses on the questionnaire regarding the impact of the Musical Futures program. The most positive responses reported that

Musical Futures had strengthened the students' motivation and ability to work together as a team. The study reported that the only statistically significant change suggested that Musical Futures improved students' general demeanor and attitude toward learning.

Iwasaki, Rasinski, Yilidrim, and Zimmerman (2013) studied the effect of singing on teaching reading. Iwasaki spent a full school year teaching one or two new songs a week to her first grade class. Eighteen students were with Iwasaki the whole year and were reminded every week to track the words while they were singing. The students were given a standardized reading assessment called the Developmental Reading Assessment (DRA; Beaver & Carter, 2012) in September before the weekly singing and in May after a year of weekly singing. Through multiple teacher-administered tasks and reading passages, the DRA measured rhyming, alliteration, segmentation, letter naming, word-list reading, spelling, decoding, analogies, structural analysis, syllables, and reading fluency skills. The results of the pre- and post-intervention assessment using the DRA indicated that all but one of Iwasaki's students made at least a year's worth of age-appropriate, reading development and a few measured above-average reading growth. The authors realize that many limitations, including limitations of internal and external validity, compromised the outcome of the study.

Many studies have explored the use of music on cognitive functioning, but only a few have compared those results to the results of using other hobbies to positively affect cognitive functioning. Habibi et al. (2014) completed a longitudinal investigation regarding the effects of music training on cognitive, social, and neural development in six- to seven-year old children. The first objective was to determine whether or not children who participated in the musical training were cognitively, socially, and

neurologically different from children in the control group (children participating in soccer training) prior to the training. The second objective was to determine whether musical skills correlated with emotional and social outcomes, which have previously been shown to be related with musical training. Assessments were made regarding the children's cognitive, motor, music and language, emotional and social development, empathy, and pro-social behavior. The children also underwent imaging of their brains to measure grey matter, cortical thickness, and surface area. The results indicated no neural, cognitive, motor, emotional, or social differences among the testing groups and no correlation between musical training and social and emotional development.

Moreno and Besson (2006) researched whether 20 eight year olds could detect varying levels of pitch changes and inaccuracies in language following either music or painting training. A pre- and post-intervention screening assessed the baseline accuracy of identifying the pitch inaccuracies of a simple sentence ending in a bisyllabic word. Each child was placed in either a painting or music group for eight weeks. The groups had 40 minute lessons twice a week. Following the eight weeks of lessons, all the children were retested using the original baseline screening. The results indicated that the children who received music lessons did not score significantly better than the children who received painting lessons.

2.3 Activity-Based Speech and Language Interventions

Cohen-Mimran, Reznik-Nevet, and Korona-Gaon (2016) examined an activity-based language intervention with 220 children, three to five years old from middle and low socioeconomic statuses (SES). The children were put into one of three groups: (a) an intervention group of children from middle SES, (b) an intervention group of children

from low SES, and (c) a control group of children from middle SES neighborhoods. Each of those three large groups were split into small groups of five to six students who, weekly, received language sessions facilitated by a speech language pathologist in collaboration with the kindergarten teacher. The activity-based intervention the authors studied has been categorized as "contextualized intervention" (Cohen Mimran, Reznik-Nevet, & Korona-Gaon, 2016, 70). Like its name implies, contextualized intervention enables children to learn life skills in discrete, natural, teacher-directed activities. After pretesting was completed to log the beginning language level of all the children, therapy sessions began. Most of the weekly session activities grew out of story books (chosen intentionally) during which the language goals and activities could naturally come about. The posttest revealed that the control group, which did not receive the activity-based language interventions, scored significantly lower than the intervention group. The intervention groups also scored on the posttest significantly higher than they had on the pretest in the areas of vocabulary, syntax, and narrative. It was the conclusion of the authors that the combination of age-appropriate, language-rich activities and small group settings stimulates language learning for children.

King, Hengst, and DeThorne (2013) studied the effects of a different type of activity-based learning. They studied the effects of the Integrated Multimodal Intervention (IMI) on persistent and severe speech sound disorders in children. IMI focuses on the quantity of target words and quality of natural speech productions of target sounds. This is carried out through the utilization of a child's full communicative inventory including augmentative and alternative communication (AAC) programs and natural speech production. A single-subject, multiple-probe research design was used

with three boys who used AAC due to their severe speech sound disorders. The multi-modal component relates to the targeting of both speech production and AAC concurrently. Baseline data were collected intermittently across the study. Generalization and control probes were conducted before and after every second or third session as intervention phase data. Instructor-prompted word lists and picture cards were drilled during intervention phase data collections to track improvement on treated and nontreated target words. All three participants demonstrated an increase in both the quality of natural speech productions and quantity of words. It was the conclusion of the authors that implementing a multi-modal approach was effective in producing positive changes in individuals with speech sound disorders.

2.4 Music Therapy and Speech-Language Therapy

Music therapy has been studied directly in the field of speech-language pathology. Yamaguchi, Akanuma, Hatayama, Otera, and Meguro (2012) investigated the effects of singing therapy on a 79-year-old woman with chronic, severe nonfluent aphasia. Aphasia is the condition of being unable to understand or express speech due to brain damage. The singing therapy used by the authors in the controlled, qualitative clinical trial was performed in three stages. During the first stage, the patient and therapist practiced singing nostalgic songs, songs with which the patient was familiar. The second intervention stage began after the woman was able to sing the first verse of each song spontaneously and repeat lyrics. During the second stage, the patient and therapist practiced a familiar tune with new lyrics. Speech, language, hearing and music therapists conducted 30 minute biweekly practice sessions for three months during this stage. At the completion of this stage, the patient could repeat lyrics and sing with the therapist or

spontaneously. The third intervention stage combined the ability to sing and repeat lyrics with rebuilding basic greetings. Cues in the lyrics of the song were given and practiced to signal the coming of the words "hello" and "goodbye." The therapist always accompanied those two words with a bow to strengthen their meaning. This stage also incorporated the relearning of body parts (i.e. ear, finger, and foot) to rhythms. At the conclusion of this third intervention stage, the patient was able to memorize words with their meaning and demonstrate that knowledge by using them in a given context. The patient's progress was measured by measuring her spontaneous speech, auditory comprehension, repetition, naming, reading, writing five times over the course of the intervention. The authors concluded that the results of their intervention suggest singing can be used as an effective rehabilitation therapy for individuals with severe nonfluent aphasia.

Similarly, Hurkmans et al. (2015) examined the effectiveness of Speech-Music Therapy for Aphasia (SMTA) on verbal communication in daily life using a case series design in five speakers with Apraxia of Speech and aphasia. Because music and communication share neural systems, SMTA was chosen to integrate speech therapy and music therapy in the treatment of individuals with Apraxia of Speech and aphasia. The speech therapy portion of treatment implemented treatment in three levels: (a) phonemes and syllables, (b) words, and (c) sentences. The music therapy portion treatment progressed from (a) singing to (b) rhythmical chanting and (c) speaking. All five participants received 24 SMTA sessions, two 30 minute sessions per week for 12 weeks. Pretreatment and posttreatment evaluations tested the intelligibility and comprehensibility of the participants' verbal communication. Standardized tests were also conducted

weekly to track improvement. The weekly and posttest batteries revealed that SMTA not only improved intelligibility of verbal communication in all participants, but improved comprehensibility, articulation of phonemes, diodochokinetic rates (or the ability to make movements quickly, specifically movements of the articulators) for four of the five participants. The posttest battery was conducted three months following SMTA and indicated that the improvements remained stable. The authors concluded that SMTA appears to be an effective treatment in the verbal communication in daily life of individuals with Apraxia of Speech and aphasia.

Numerous studies have investigated relationships between music, speech, and their shared pathways in the brain. Sammler, Kotz, Eckstein, Ott, And Friederici (2010) researched whether the corpus callosum's communication between the left and right hemispheres is the bases of syntactic and prosodic interaction and whether syntactic information takes an anterior or posterior pathway through the corpus callosum to guide prosody. Participants included eleven individuals, ranging in age from 23-71 years old, with lesions in the anterior two-thirds of the corpus callosum or patients with lesions in the posterior third of the corpus callosum. These patients participated in numerous syntactic and prosodic tasks. Sequences of sentences were given to the patient during which the patient had to indicate whether the sentence contained (a) correct prosody and correct syntax, (b) incorrect prosody but correct syntax, (c) correct prosody but incorrect syntax, or (d) incorrect prosody and incorrect syntax. A combination of electroencephalograms and electrooculograms were attached to the patient during the time of the data acquisition to provide more accurate information about what areas of the brain were being used. These data support the authors' hypothesis that speech processing

courses in both hemispheres of the brain by way of the posterior portion of the corpus callosum.

Brown, Martinez, and Parsons (2006) evaluated, through positron emission tomography (PET) scans, parallel areas used in the brain during melodic phrase generation and sentence generation. Ten individuals ranging from 19 to 46 years of age participated in this study. Each participant completed a novel melody, completed a given sentence fragment, and then rested with closed eyes. The PET scans revealed during both melodic phrase and sentence generation, the following areas of the brain were activated and working together: "primary motor cortex, supplementary motor area, Broca's area, anterior insula, primary and secondary auditory cortices, temporal pole, basal ganglia, ventral thalamus, and the posterior cerebellum" (Brown et al., 2791). The authors concluded that music and language generation share many crucial, parallel brain paths.

Concluding that both music and language may share pathways in the brain leads to an area of research that investigates the use of music to regain language lost by a neurological source. Tomaino (2010) explored the recovery of fluent speech through a musician's previously learned repertoire. The case study implemented speech and music therapy with an 80 year old former musicologist who lost his fluent speech following a stroke. He was given an unspecified amount of speech therapy and daily (5 times a week) music therapy. A full assessment of his musical skills pre-therapy demonstrated he was able to tap back rhythms, recognize songs, and demonstrate appropriate prosody. He was unable, however, to sing on pitch, produce appropriate tone, or sing any lyrics. During the time of therapy, the patient's singing improved, word retrieval was better immediately after singing each song, but would then show impairment the more he tried to verbalize.

Four months after his admission into this rehabilitation, his phrases of word retrieval and fluency were at 80% accuracy. The author concluded that the use of music therapy can be effective for persons with aphasia. An additional conclusion suggested that musicians may benefit from music therapy more than from traditional therapies.

Gattino, Riesgo, Longo, Leite, and Faccini (2011) considered the effects of Relational Music Therapy (RMT) in verbal, nonverbal, and social communication in children with autism. A randomized control trial compared 12 boys receiving music therapy and 12 boys receiving standard clinical routines including examinations and consultations. Each child in the music therapy group received three 30 minute music therapy assessment sessions, sixteen 30 minute weekly RMT intervention sessions, and one culminating 30 minute music therapy session in addition to their weekly clinical activities. Each child in the control group received his standard, weekly routine in clinical activities. Pre and posttest assessments using the Brazilian Childhood Autism Rating Scale by blind evaluators showed no statistically significant difference in the areas of verbal, nonverbal, and social communication. The effects of the use of RMT on communication skills in individuals with Autism Spectrum Disorder were inconclusive. The authors concluded that further investigations require more intense research designs including smaller effect sizes and more accurate assessment tools.

Geist, McCarthy, Rogers-Smith, and Porter (2008) examined and documented a case-study, co-treatment model of music therapy services and speech-language therapy services in a four year old child with global developmental delay. The main goal targeted by the co-treatment was the child's greetings and increased engagement during group story activities. The music therapist addressed this goal during individual music therapy

sessions and gradually worked up through group therapy to the classroom environment. The speech therapist also acted as a consultant to the classroom teacher and music therapist on communication strategies. The music therapist, speech therapist, and classroom teacher all documented that the child's off-task behaviors decreased as the co-treatment progressed. As an added post-intervention validation, pre- and post-treatment videos were given to ten pre-service teachers blind to the case study. The pre-service teachers were asked to indicate in which video they felt the child was most involved in the classroom. Ten out of ten teachers selected the post-treatment video as the one they felt the child was most involved in the classroom. Though the case-study produced positive, desirable results, the authors indicated the challenge of documenting the value and benefit of music in a person's life. They also noted that not all children may benefit from music therapy treatment as some children are not motivated by music.

2.5 Summary

Music has been used to satisfy many needs and demonstrate many potential links to enhance education (e.g., Portowitz, Peppler, & Downton, 2014; Hallam, Creech, & McQueen, 2016; Kaviana, Mirbaha, Pournaseh, & Sagan, 2014; Iwasaki, Raskinski, Yildrim, & Zimmerman, 2013; Habibi et al. 2014; & Moreno & Besson, 2006), strengthen activity based practice, (e.g., Cohen-Mimran, Reznik-Nevet, & Korona-Gaon, 2016; King, Hengst, & DeThorne, 2013; Yamaguchi, Akanuma, Hatayama, Otera, & Meguro, 2012; Hurkmans et al. 2015; Sammler, Kotz, Eckstein, Ott, & Friederici, 2010; Brwon, Martinez, & Parsons, 2006) and motivate students (e.g., Tomaino, 2010; Gattino, Riesgo, Longo, Leite, & Faccini, 2011; Geist, McCarthy, Rogers-Smith, & Porter, 2008). In each of the previous studies, the research questions focused on skills and goals that were generalizable for participants. Music, by its very nature is generalizable. Therefore,

music is a logical method to exercise budding skills and techniques. Repetition, the involvement of pitch and fluency, and the catchiness of melodies render songs and music a practical tool to bolster accurate articulation acquisition.

CHAPTER 3: METHODOLOGY

To effectively explore the use of songs as an articulation exercise, this study was a multiple-probe single-subject research design. The investigation of music therapy itself is not novel, but the investigation of music as an articulation intervention is. Because this idea and practice are still relatively novel, the research is yet preliminary and exploratory.

3.1 Rationale

The rationale driving this study was based on the researcher's experience as a Speech-Language Pathologist Assistant with elementary school children with articulation disorders. Throughout past school years, the researcher has observed the challenge of families to complete homework or worksheets for speech class and the fruitlessness of these efforts. Music in school is viewed by students less often as hard work and more often as an enjoyable time to make music with peers and teachers. Cohen (1994) stated that music provides a welcome and agreeable avenue for communication and learning as an alternative to traditional learning where a child might otherwise be disengaged. It is hoped that by conducting a study with three participants, findings will show the effectiveness of using music as an articulation exercise, a beneficial supplement to a traditional, repetitive approach.

3.2 Participants

At the beginning of the study, a parental consent of the study was given to each child with a speech-only diagnosis as indicated by the children's speech therapy service provider at a private elementary school. Six children and their parents were chosen and invited to participate in the study based on the following criteria: (1) between 4 and 7 years of age, (2) have an articulation disorder, (3) not present or be diagnosed with any

comorbidities or disorders, and (4) not be eligible for graduation from their speech program within 6 months of the start of the study. Three children were unable to participate due to unavailability. The parents of the other three children who met the criteria were given a parental consent letter and an introductory survey. Participant 1was a four year old male and Participant 2 was a four year old female, both enrolled in four-year-old kindergarten. Participant 3 was a seven year old female enrolled as a second grade student. The articulation errors of Participants 1 and 2 were voiced "th" and voiceless "th" and the errors of Participant 3 were "sh, ch, and j." All three participants were new to therapy. Participant 1 had recently been informally assessed by a speech-language pathologist, but no formal therapy or practice followed that assessment.

3.3 Setting

This study was conducted within a private school that teaches students from four-year-old kindergarten through twelfth grade in the southeastern United States. The research sessions were conducted for 60 minutes a week in two, 30 minute sessions. The therapy sessions took place in an unoccupied kindergarten classroom immediately after school dismissal. Due to safety regulations put in place by the school, the researcher was asked to take child safety courses and maintain the minimum requirement to uphold the child safety regulations enacted by the school. Because of the child safety regulations, at least one parent of the participant or one other teacher trained in the school's child safety regulations was required to be present at all times.

3.4 Instruments

Parental consent was signed by parents and given to the researcher. This consent enumerated the purpose, methods, and proposed timeline of the study. With the consent,

parents were also given a brief questionnaire section regarding their child's attraction to and experience with music, favorite song, music most commonly listened to as a family (e.g. at home, in the car), the parent's involvement in their child's homework, and an approximate success rate with prior speech homework. This questionnaire was used exclusively as an informative tool to educate the researcher as she worked with the participants.

Word lists, adapted by the researcher from Snyders and Stuckeys (2011) *Articulation: Quick take along mini book*, containing words with the participant's target sound were used for all bi-weekly baseline and cold probe data. Only word lists that matched the child's target sound were used for that participant. Identical word lists were used for each stage of data retrieval to accurately gauge progress.

Identical pre- and post-intervention screenings were used to measure the efficacy of the intervention from the beginning of traditional therapy to the completion of the intervention. The pre- and post-screenings were presented as a table of pictures. The child was asked to identify one at a time. The pictures assessed all possible problematic phonemes and pinpointed the areas of articulation need for that participant.

Data were also collected from the parents regarding their use of the homework tools provided to them. A follow-up parental survey was administered after the research period was completed. Questions pertaining to user satisfaction, perceived convenience, and willingness to continue using the musical intervention were measured with Likert rating scales. Parents also shared anecdotal opinions of the music intervention throughout the study. For example, the parent of Participant 1 shared a preference regarding the tracking of how frequently Participant 1 practiced the musical intervention. Rather than

sending tracking the practice time electronically, the parent requested to track the practice on paper.

3.5 BLOOMZ

Parents of the participants were given access through the BLOOMZ (2016) app to the articulation videos to allow the child to have access to the song for homework completion. The video link was made available to the parents at all times after the musical intervention for their child began. The software through which the video was posted rendered the video accessible only to those with the link.

The calendar portion of the BLOOMZ app denoted speech therapy session days and times, the homework assignment, and the number of desired repetitions for the assignment. The data tracker found in the app was available for the parents to log the participant's homework activity. Participant 1's parent indicated a preference of using a paper-and-pen homework log and kept accurate and close data using that medium. Participant 2's parent did not log the musical practice through either the BLOOMZ app or with paper-and-pen. This parent reportedly would forget to write it down but would verbally communicate their practice time to me when they came for the next therapy session.

3.6 Procedures

Recruitment. Prior to the beginning of the study, parental consent was given to each child who met the inclusion criteria and was available to attend the speech sessions. Once the participants were selected, the researcher invited and gave instructions for the BLOOMZ application. BLOOMZ served as a phone and/or computer based newsfeed. BLOOMZ provided an all-in-one means for the researcher to send calendar reminders,

post classroom updates, and send real-time messages to parents. BLOOMZ served as the medium where parents found articulation videos, data tracking pages, and additional resources.

Pretest. At the beginning of the study, each participant was given a pre-intervention, standardized screening. This screening measured the accuracy at which the participants could produce words containing his or her target sound.

Baseline Phase. Each participant began the baseline, traditional speech therapy the same week. Cold-probe data was taken at the beginning of each session. After a stable baseline had been established by a minimum of three data points, the intervention was introduced to Participant 1. Once a stable baseline was established, Participant 1 moved into the intervention phase.

Intervention phase. The duration of the interventions for participants lasted 11 weeks. The start times for the intervention, were staggered across participants to demonstrate that the increase of mastery was due to the introduction of the musical intervention. The researcher continued to take cold probe data at the beginning of each session throughout the intervention phase. When, according to the cold probe data, Participant 1 demonstrated a stable trend after the introduction of the musical intervention portion, Participant 2 was provided with the intervention. The beginning of Participant 2's intervention coincided with the start of Spring Break and therefore added an extra challenge level to following through with the musical intervention as homework for Participant 2. Because of the time frame in which this study took place, Participant 3 was unable to move forward from the baseline phase.

Posttest. At the end of the study, Participants 1 and 2 were given a post-intervention, standardized screening that was identical to the pretest screening. This screening measured the accuracy at which the participants could produce words containing his or her target sound. Participant 1 completed the posttest with 100% accuracy. Participant 2 completed the posttest with 80% accuracy. Participant 3 was unable to take the posttest since they were also unable to begin the intervention portion of the study.

Parent Survey. Parents of the participants were given an initial survey during the first session. The paper-and-pen survey asked open-ended questions regarding the participant's musical exposure in the following categories: (1) music listened to regularly at home/in the car, (2) musical TV shows/movies watched regularly by the participant, (3) music lessons, (4) concert/recital attendance, and (5) participant's favorite song. Likert rating scales were used for the final three questions of the initial survey to gauge the parent's involvement in their child's homework completion. This initial survey served solely to inform the researcher as she worked with the participants.

A six-question, paper-and-pen survey was completed by the parents at the conclusion of the intervention stage regarding their perceptions of the musical therapy intervention. The follow-up survey contained three Likert Rating scales questions about accessibility of the materials, user satisfaction, perceived convenience, and willingness to continue using the musical intervention. The final three questions of the survey were yes/no questions regarding the parent's perceptions of the behavior and general speech improvement of their child. This survey was used to answer the second research question regarding parent perceptions of the use of musical interventions as a take-home exercise.

3.7 Data Collection

Identical pre- and post-intervention screenings were collected for each of the participants regarding their target sound using the articulation portion of the *Clinical Evaluation of Language Fundamentals-5* (*CELF-5).* Bi-weekly cold-probe data were collected using a criterion-referenced word list based on the sound errors of the participant. The participants were asked to imitate ten words containing the participant's error sound at the beginning of each session without prompting or instruction. The participant's first imitated response was recorded by hand as "+" or "-" based on the correct or incorrect production of their target sound.

Data was also collected from the parents during the final session regarding their use of the homework tools provided to them. The BLOOMZ app contained a calendar, data tracker, resource link, and visual reminder to encourage uniformity in the data being collected.

CHAPTER 4: RESULTS

4.1 Data Analysis

Data analysis for the proposed study included a visual analysis for positive trends between the use of music as a supplement and traditional drilling. Quantitative methods were used to measure the participants' improvement of target sounds over time.

Parents were given a survey at the completion of the study regarding their perceptions of the musical therapy intervention. The survey contained three Likert Rating scales questions regarding accessibility of the materials, user satisfaction, perceived convenience, and willingness to continue using the musical intervention. The final three questions of the survey were yes/no questions regarding the parent's perceptions of the behavior and general speech improvement of their child. Parent responses to the pre- and post- intervention surveys were analyzed for common themes. Results of the study are presented below as they relate to each of the research questions.

4.2 Results

Effects on articulation. Based on the data collected over the course of the study, all three participants demonstrated varying levels of improvement. Due to the nature of the multiple-probe, single subject design, Participants 1 and 2 began their musical intervention at different times. This staggered start time allowed for a visual analysis of the participant's progress before and during the musical intervention. Participant 3 was unable to begin the musical intervention during the course of this study due to the progression and timeline of the study. While Participants 1 and 2 received traditional speech therapy and the musical intervention over the course of this study, Participant 3

received traditional speech therapy for the duration. See Table 1 and Table 2 for the results for Participants 1 and 2. See Table 3 for the results of Participant 3.

As Table 1 shows, Participant 1's voiced "th" cold probe data during traditional speech therapy ranged from three to seven words correct out of ten. Participant 1's mean number of words correct during the traditional therapy period was six out of ten. Despite missed sessions during the intervention phase, the participant's mean number of words correct during the musical intervention period was 9.45 words correct out of ten, with scores ranging from six of ten correct to a perfect ten of ten correct. For voiced "th" words, Participant 1 showed an approximate 30% increase from traditional speech therapy to the use of musical intervention. This percentage increase was calculated by converting mean number of words correct to a percentage (multiplying by ten) and then subtracting the Intervention mean score percentage from the Traditional Speech Therapy mean score percentage.

As Table 2 shows, Participant 1's voiceless "th" cold probe data during the traditional speech therapy ranged from zero to six words correct out of ten with a mean score of four out of ten words correct during the four baseline, traditional speech therapy sessions. Again, despite the absences and missed therapy sessions following the introduction of the musical intervention, Participant 1 demonstrated a 50% mean increase from traditional speech therapy to the use of the musical intervention. Over the course of 15 sessions, Participant 1 demonstrated a 40-50% increase in articulation accuracy. Again, these percentage increase values were calculated by converting mean number of words correct to a percentage (multiplying by ten) and then subtracting the Intervention mean score percentage from the Traditional Speech Therapy mean score percentage.

Table 1 reflects Participant 2's voiced "th" mean and range during baseline and the musical intervention stages of the study. Participant 2 demonstrated a mean articulation accuracy of approximately four out of ten (with scores ranging from zero to eight out of ten correct) over the course of 14 baseline, traditional therapy sessions. Through the course of four musical intervention sessions, Participant 2 increased mean accuracy to almost seven out of ten (with scores ranging from five to eight out of ten correct). Table 2 reflects Participant 2's voiceless "th" accuracy. During 14 sessions of baseline, traditional speech therapy intervention, Participant 2 accurately articulated a mean of almost two words out of ten correct (1.86 out of 10), with scores ranging from zero to six out of ten. During the four sessions of musical intervention, Participant 2 demonstrated a mean articulation accuracy of a little more than two out of ten correct (2.25 out of 10) with scores ranging from one to three out of ten. Although Participant 2 only completed four sessions of musical intervention, mean scores were improved by approximately 4%. This percentage increase was also calculated by converting mean number of words correct to a percentage (multiplying by ten) and then subtracting the Intervention mean score percentage from the Traditional Speech Therapy mean score percentage.

Participant 3 was unable to move forward into the musical intervention stage of the study due to the progression and timeline of the research design and the progress of the other participants. Therefore, Participant 3 was able to complete 15 sessions of traditional speech therapy. Table 3 summarizes the mean and range scores of Participant 3's target sounds. Across the course of 15 sessions, Participant 3 was able to increase mean scores from zero to as high as 1.73 correct words out of 10. While the progress may

seem minimal, Participant 3's baseline data were consistently zero throughout the first ten sessions of therapy. Participant 3's mean scores increased 17% in the final five sessions of therapy. The parent of Participant 3 shared that there was an intentional effort by the participant at home to improve the target sounds while reading. This percentage increase was calculated by converting number of words correct to a percentage (multiplying by ten) and then subtracting the Intervention mean score percentage from the Traditional Speech Therapy mean score percentage.

TABLE 1.

MEAN AND RANGE OF COLD PROBE DATA ACROSS CONDITIONS FOR VOICED "TH" WORDS CORRECT

	Traditional Speech Therapy			**Intervention**		
Participant	**Mean**	**Range**	**Time**	**Mean**	**Range**	**Time**
Participant 1	6 of 10	3-7 of 10	4 sessions	9.45 of 10	6-10 of 10	11 sessions
Participant 2	4.21 of 10	0-8 of 10	14 sessions	6.75 of 10	5-8 of 10	4 sessions

TABLE 2.

MEAN AND RANGE OF COLD PROBE DATA ACROSS CONDITIONS FOR VOICELESS "TH" WORDS CORRECT

	Traditional Speech Therapy			**Intervention**		
Participant	**Mean**	**Range**	**Time**	**Mean**	**Range**	**Time**
Participant 1	4 of 10	0-6 of 10	4 sessions	9.09 of 10	6-10 of 10	11 sessions
Participant 2	1.86 of 10	0-6 of 10	14 sessions	2.25 of 10	1-3 of 10	4 sessions

TABLE 3.

PARTICIPANT 3'S TRADITIONAL SPEECH THERAPY COLD PROBE DATA FOR VOICELESS FRICATIVES & AFFRICATES "SH," "CH," "J"

	Traditional Speech Therapy		
	Mean	**Range**	**Time**
"SH"	1.73 of 10	0-10 of 10	15 sessions
"CH"	0.46 of 10	0-7 of 10	
"J"	0.33 of 10	0-4 of 10	

Parent responses. During the first session of this study, the parents of all three participants completed an initial survey regarding musical experience and homework habits. The initial survey indicated that none of my participants had previously been to any kind of concerts or recitals and none had participated in music lessons of any kind. The type of music that the participants listened to on a consistent basis ranged from current children's television shows and nursery rhymes to local radio stations. Two of the three parents indicated that they had never been given speech homework before and therefore had never practiced them. The third parent (parent of Participant 1) indicated that they were neutral regarding worksheets and word lists as a successful means of practicing speech at home. The parent of Participant 1 shared anecdotally during a speech session that they had drilled speech sounds using flashcards earlier in the year before the beginning of this research study.

At the completion of the intervention, the parents of Participant 1 and 2 completed a follow-up survey about the use of the musical intervention as homework. (The parent of Participant 3 did not complete a follow-up survey since Participant 3 had not yet begun

the musical intervention.) Both parents "strongly agreed" (the highest rating) that the speech videos were easily accessible and user friendly on all devices on which they accessed them; "strongly agreed" that they found the video assignments to be easier to complete with their child than word lists, drills, or worksheets; and "strongly agreed" that they would be willing to continue working with their child using this music video method of homework assignment (as opposed to a worksheet/drill homework method.) Both parents indicated "yes," that they heard/observed their child singing and/or humming his/her articulation song at times without the video other than when they were intentionally working on the assignment; "yes," that the child watched the video more times than was requested in the speech assignment; and "yes," they have noticed a difference in their child's articulation/speech during the duration of the research study. The parent of Participant 2 hand wrote beside her "yes" to the final question, "Some change."

CHAPTER 5: DISCUSSION

Participants 1 and 2 were both four years old and working on the voiced and voiceless "th" sounds. Though their age and articulation errors were the same, both participants demonstrated different results. This may be due largely to the fact that every human is unique and continuously growing and changing in their own ways. The researcher used identical therapy techniques and activities with them for both the traditional speech therapy and the musical intervention, however, Participant 1 showed greater progress and development over the course of the study. The traditional therapy for Participant 1 was two weeks long; a total of four, 30 minute therapy sessions. The musical intervention for Participant 1 was nine weeks long, a total of only 11 sessions due to school holidays and absences. Despite the missed sessions during the musical intervention period, Participant 1 showed a significant increase in articulation accuracy. Participant 2 spent approximately eight weeks (14 sessions) in the baseline, traditional speech therapy stage and three weeks (four sessions) in the musical intervention stage. Participant 2 was able to attend three more sessions than Participant 1 because of the Participant's availability. Some additional considerations for these differences are described below.

5.1 Considerations

Anecdotally, the parents of all three participants demonstrated varying levels of involvement of personal participation. From the beginning, the researcher encouraged the parents to be as involved as possible in the therapy sessions to aid in their understanding of their child's sounds with the hope that the parent could be an added benefit to the child while practicing the musical intervention at home. The parent of Participant 1 was very

involved, friendly, and focused during the therapy sessions and gave some indication that they were practicing at home with their own tools during the weeks of baseline data retrieval before the musical intervention even started. Participant 1's parent appeared to hold Participant 1 to a very high standard. Periodically, the researcher would show the parent the scatter plot data that visually proved the improvement the participant was making to relieve some of the parent's concerns.

The parent of Participant 2 was rarely involved or focused on the speech therapy during the sessions. While Participant 2's parent was always friendly and encouraging, they demonstrated a more hands-off approach to the therapy and musical intervention. This parent shared that they were more than happy to help the child with the musical intervention, however—based on the number of times the parent communicated that they had completed the musical intervention—completing the homework was challenging. Even though the musical intervention was not a high priority, the parent still indicated that it was more convenient than typical homework and they would be willing to continue to use this type of video intervention as homework.

The parent of Participant 3 was not present for the majority of the therapy sessions. Even though the parent was frequently absent, they still regularly checked in with the researcher and asked for updates. The parent appeared friendly, encouraging, and excited about the traditional therapy and musical intervention. Participant 3's parent shared after one of the later sessions that Participant 3 had been self-correcting the target sound during their reading time in the evenings.

Another factor to consider when analyzing this study is the success rate of traditional speech therapy. This study was not intended to unveil any ineffectiveness of

traditional speech therapy, but rather to explore a technique that could potentially supplement and enhance the use of traditional speech therapy. Because Participant 3 was unable to begin the musical intervention portion and still demonstrated progress is a visual reminder of the effectiveness of traditional speech therapy. Because Participant 2's data indicated some progress during the baseline phase is another visual reminder of the effectiveness of traditional speech therapy.

A consideration aligned with the traditional speech therapy is the consideration of one-on-one speech therapy versus group therapy. In the region in which this study took place, most school-based speech therapy programs have a caseload that necessitates group therapy. In one-on-one therapy, the speech pathologist is able to work with one child for a 30 full minutes. In group therapy, the speech pathologist works with a group of between two to five students at a time for 30 minutes. If the speech pathologist were able use every minute in 30 minutes and disperse the time equally between five students, each child would receive six minutes of speech therapy. Even if the speech pathologist were only working with two students, each of the two students would only receive 15 minutes each of direct therapy. In a one-on-one therapy session—which was used in this research—the student gets double the direct specialized instruction than even the smallest number of students in a group therapy session would get.

5.2 Limitations

As is the case in any research study, limitations to this study included time, participation, and investment. Time was factored around the school schedule of the participants and the work and academic schedule of the researcher. All therapies improve and produce additional results with added time.

As noted previously, parental participation varied for each participant. Parental participation may not always be a limitation, but should be considered when interpreting the results of this study.

Another limitation of this study was the number of absences of the participants over the course of the study. Although the participants missed valuable instruction time, the absences created a unique opportunity to observe whether or not a regression would occur. The absences caused by spring break created an isolated, two-session regression in Participant 2. The same absences appeared not to affect Participants 1 and 3. The question remains, however: could the participants have made even more progress had they attended or been able to make up those missed sessions?

A final limitation was the participant size. Although single-subject research lends itself to a sample size between three and five, a maximum participation number would have provided this study with a broader set of data to identify more soundly whether or not the musical intervention was the most crucial catalyst in the therapy of the participants. Even with only three participants, the cold probe data indicated that the staggered start times of the musical intervention was an effective and substantial catalyst.

5.3 Implications

As it is stated in the paper, the investigation of music therapy itself is not novel, but the investigation of music as an articulation intervention is. Because this idea and practice are still relatively novel and the research is yet preliminary and exploratory, this study provides a gateway for various further research studies. An immediate implication for further research would be a study with more than three participants over a longer amount of time. Though this study demonstrated many things with three participants over

three months, there is much more that could be uncovered with more participants over a longer period of time. Additionally, researchers could explore the use of this intervention with traditional group speech therapy as opposed to the use of this intervention with one-on-one speech therapy as was demonstrated and observed here.

Another implication for further research is the use of musical interventions on individuals who have varied abilities, comorbidities, and diagnoses. Music therapy provides individuals with special needs, brain injuries, learning disabilities, gross motor challenges etc. many opportunities to grow and learn; many of these individuals often also receive speech therapy. How effective could this musical intervention prove to be when used as a supplement to traditional speech therapy with people with various comorbidities or diagnoses as well?

The tunes in the musical intervention used in this research were traditional American folk songs like Old MacDonald and Twinkle, Twinkle Little Star. Additional research could explore the use and effectiveness of various musical styles that touch on different tastes or different cultures. And because speech therapy is not exclusive to English speakers, while other musical styles and cultures are being explored, perhaps this could be adapted to be used as an effective supplement in other languages as well.

5.4 Summary

The results of this research implied that phonologically-rich songs, taught in speech therapy and practiced in the speech session and at home with the parent/guardian, are an effective exercise to supplement therapy in kindergarten children with articulation disorders. The parent's/guardian's perceptions of using singing as a take-home, guided exercise were favorable and demonstrated a willingness to continue using this

intervention in the future. Overall, this intervention demonstrated positive progress with all participants and a promising future in the field of speech and language intervention.

REFERENCES

Beaver, J., & Carter, M. (2012). Developmental Reading Assessment (2nd ed.). Upper Saddle River, NJ: Pearson.

BLOOMZ, One App for All Your Parent Communication. (2016). Retrieved April 29, 2017, from https://www.bloomz.net/

Brown, S., Martinez, M. J., & Parsons, L. M. (2006). Music and language side by side in the brain: A PET study of the generation of melodies and sentences. *European Journal of Neuroscience, 23*, 2791-2803.

Cohen, N. S. (1994). Speech and song: Implications for therapy. *Music Therapy Perspectives, 12*, 8-14.

Cohen-Mimran, R., Reznik-Nevet, L., & Korona-Gaon, S. (2016). An activity-based language intervention program for kindergarten children: A retrospective evaluation. *Early Childhood Education Journal, 44*, 69-78.

Feuerstein, R., Feuerstein, R. S., Falik, L., & Rand, Y. (2006). Creating and enhancing cognitive flexibility: The Feuerstein instrumental enrichment program. Jerusalem, Israel: ICELP Press.

Feuerstein, R., Rand, Y., & Rynders, J. E. (Ed. 2). (1988). Don't accept me as I am. New York, New York: Plenum Press.

Gattino, G. S., Riesgo, R. S., Longo, D., Liete, J. C. L., & Faccini, L. S. (2011). Effects of relational music therapy on communication of children with autism: A randomized control study. *Nordic Journal of Music Therapy, 20* (2), 142-154.

Geist, K., McCarthy, J., Rodgers-Smith, A., & Porter, J. (2008). Integrating music therapy services and speech-language therapy services for children with severe communication impairments: A co-treatment model. *Journal of Instructional Psychology, 35* (4), 311-316.

Habibi, A., Ilari, B., Crimi, K., Metke, M., Kaplan, J. T., Joshi, A. A., ... & Damasio, H. (2014). An equal start: Absence of group differences in cognitive, social, and neural measures prior to music or sports training in children. *Frontiers in Human Neuroscience, 8*, 1-11.

Hallam, S., Creech, A., & McQueen, H. (2016). The perceptions of [non-music] staff and senior management of the impact of the implementation of the musical features approach on the whole school. *British Journal of Music Education, 33* (2), 133-157.

Hurkmans, J., Jonkers, R., de Bruijn, M., Boonstra, A. M., Hartman, P. P., Arendzen, H., & Reinders-Messelink, H. A. (2015). The effectiveness of speech-music therapy for aphasia (SMTA) in five speakers with apraxia of speech and aphasia. *Aphasiology, 29* (8), 939-964.

Hyde, K. L., Lerch, J., Norton, A., Forgeard, M., Winner, E., & Evans, A. C. (2009). Musical training shapes structural brain development. *Journal of Neuroscience, 29,* 3019-3025.

Iwasaki, B., Rasinski, T., Yildirim, K., & Zimmerman, B. S. (2013). Let's bring back the magic of songs for teaching reading. *The Reading Teacher, 67,* 137-141.

Kaviani, H., Mirbaha, H., Pournaseh, M., & Sagan, O. (2013). Can music lessons increase the performance off preschool children in IQ tests? *Cognitive Process 15,* 77-84.

King, A. M., Hengst, J. A., & DeThorne, L. S. (2013). Severe speech sound disorders: An integrated multimodal intervention. *Language, Speech, and Hearing Services in Schools, 44,* 195-210.

Klein, P. S. (1996). Early intervention: Cross-cultural experiences with a mediational approach. New York, New York: Garland.

Law, J., Boyle, J., Harris, F., Harkness, A., & Nye, C. (2000). Prevalence and natural history of primary speech and language delay: Findings from a systematic review of the literature. *International Journal of Language & Communication Disorders*, 35 (2), 165–188.

Moreno, S., & Besson, M. (2016). Musical training and language-related brain electrical activity in children. *Psychophysiology, 43,* 287-291.

Ogden, J. N. (1982). A study of the value of musical activities in articulation therapy (Unpublished master's thesis). University of Kansas, Lawrence.

Portowitz, A., Peppler, K. A., & Downton, M. (2014). In harmony: A technology-based music education model to enhance musical understanding and general learning skills. *International Journal of Music Education, 32,* 242-260.

Sammler, D., Kotz, S. A., Eckstein, K., Ott, D. V. M., & Friederici, A. D. (2010). Prosody meets syntax: The role of the corpus callosum. *Brain: A Journal of Neurology, 133,* 2643-2655.

Snyders, N. E., & Stuckey, K. (2011). Articulation: Quick take along mini-book. Greenville, SC: Super Duper Publications.

Stone, J. (1998). The animated-alphabet: Story, song, and action book. La Mesa, CA: J. Stone Creations.

Tomaino, C. M. (2010). Recovery of fluent speech through a musician's use of prelearnned song repertoire: A case study. *Music and Medicine, 2* (2), 85-88.

U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. (2015). Communication disorders and use of intervention services among children aged 3-17 years: United States, 2012 (NCHS Data Brief No. 205). Retrieved from https://www.cdc.gov/nchs/data/databriefs/db205.pdf

Wan, C. Y., & Schlaug, G. (2010). Music making as a tool for promoting brain plasticity across the life span. *Neuroscientist, 16*, 5, 566-577.

Yamaguchi, S., Akanuma, K., Hatayama, Y., Otera, M., & Meguro, K. (2012). Singing therapy can be effective for a patient with severe nonfluent aphasia. *International Journal of Rehabilitation Research, 35*, 78-81.

Zoller, M. B. (1991). Use of music activities in speech-language therapy. *Language, Speech, and Hearing Services in Schools, 22*, 272-276.