ABSTRACT

Title of Dissertation: THE EFFECTS OF WITH-TEXT AND WITHOUT-TEXT SONG PRESENTATION STYLES ON PRESCHOOLERS' SINGING VOICE USE AND PITCH ACCURACY

Jessica Leigh Kendal, Doctor of Philosophy, 2018

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The main purpose of this study was to examine the effects of with-text and without-text song presentation styles on the song-singing competencies of singing voice use and pitch accuracy in preschool children. A secondary purpose of the study was to discern if there were any relationships between preschoolers' tonal developmental music aptitude, song presentation styles, singing voice use, and pitch accuracy. A total of twenty-nine 3.5- to 5-year-old preschoolers from a university children's center in the Mid-Atlantic United States were randomly assigned within intact classes to either a text-only song presentation style or a syllable-text song presentation style when being taught two new, unfamiliar criterion songs within the context of weekly 30-minute music and movement lessons at the center. Participants in the text-only control condition (n =13) heard and sang the criterion songs with text for the entirety of the 11-week study; participants in the syllable-text intervention condition (n =16) heard and sang the criterion songs on a

neutral syllable for the first six weeks of the study, then with the associated text for the remaining five weeks. All participants were pretested for developmental tonal music aptitude and were recorded singing a familiar song to determine baseline singing competencies before the start of the study; all participants were recorded singing the two criterion songs at the conclusion of the study for posttest measurement. Recordings were evaluated by three trained raters using Rutkowski's (1998) SVDM and were evaluated by the researcher for pitch accuracy percentage scores. Results of descriptive statistical analyses showed no significant differences in median scores between the groups for singing voice use or pitch accuracy at posttest. Results of correlational analyses suggest that presenting new songs initially without text may support preschoolers' use of singing voice, while presenting new songs with text may support preschoolers' pitch accuracy. These analyses also showed minimal correlation between tonal developmental music aptitude and singing scores. Pitch accuracy was found to be highly correlated with singing voice use.

THE EFFECTS OF WITH-TEXT AND WITHOUT-TEXT SONG PRESENTATION STYLES ON PRESCHOOLERS' SINGING VOICE USE AND PITCH ACCURACY

by

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Soli Deo Gloria.

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CHAPTER 1

INTRODUCTION

Impetus

"Okay, Kaden[1], your turn! Sing this after me, okay?"

(Kaden, a kindergarten student, shakes his head at me, looking anxious despite the generally happy and relaxed music classroom environment.)

"I don't want to, Ms. Kendal. I'm not a good singer."

Three Years Later

The weather outside is drizzly and dreary, but inside, the preschool children's center is already colorfully coming to life on a Thursday morning. "Sitting spots" in a rainbow of colors make a large circle on the carpet of the high-ceilinged, many-windowed great room. Our music learning plan is on a medium-sized rolling easel, and the area is framed with tiny tables and chairs, short bookshelves packed with books and building blocks, and a few potted indoor trees. "Largo," the plush turtle mascot of our music class, sits on one of the tiny chairs near the circle, holding a toy microphone. Children begin to emerge in a pseudo-line from a nearby classroom, choosing a sitting spot—some almost running, bouncing; some still sleepy and wandering. As I sit down on my spot, I am tapped on the arm by the little girl sitting to my left. Eyes big, she says with great seriousness:

"Ms. Kendal! Did you know? This is my very first time sitting on a purple dot!"

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[1] All child names have been changed to protect anonymity.

"Good morning, Red Room! We are so very happy to see you today—we have wonderful music to make! But first: What do we need to turn on to be ready to sing our hello song this morning?" (Many hands shoot up, bodies leaning forward and half off sitting spots; others watch cautiously. The concept of waiting to be called on is moderately embraced, and sometimes entirely abandoned in the desire to contribute. Some answers are pantomimed.)

"Ow-ah listening e-yahs!" "Singing voices!" "Waving hands!" "Aw wiggly tums!" "Shwuggy shoulduhs!"

Each suggestion is followed by a little guided movement and appropriate sound effects as a group. Singing voices are "turned on" with a few gentle vocal swoops and glides into our head voices, and then we are ready to sing to each other and to Largo. My co-teacher sings a preparatory "Here we sing!" on so-mi-so, and then we sing a bouncy, duple meter Mixolydian melody, gesturing along:

"Hello, ev'ryone, how are you?
I'm so happy to music with you!
Singing, chanting, moving too!
Hello, ev'ryone, how are you?"

A scan of the room while we sing shows a variety of responses: some enthusiastic singing and moving, some participating in the gestures but not the singing, and some sitting and staring.

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"Today, friends, Largo asked if we could sing one of his very favorite songs. I wonder if you might know it? Twinkle, Twinkle, Little Star?"

"I KNOW that one! I sing it at nighttime!"

"My mom sings that to me!

(Heard from somewhere in the circle, sotto voce: "tvinkle, tvinkle, wittle stah…")

"Wonderful. I knew you could help us sing this to Largo today. He also asked if, after we sing the song to him, we could practice some 'star songs'—just little tiny songs the stars might sing as they twinkle in the sky. We'll even need a few friends to sing their very own star song into this microphone! Are you ready?"

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What would humanity be without song? Sometimes defined as "artful presentation of words with music," (Feierabend, Saunders, Holahan, & Getnick, 1998) song is a uniquely human gift, an integral part of the human experience, and begins to emerge spontaneously even in early childhood (Whiteman, 2009). Hearing and creating song can be a source of joy, a balm to sadness, a gateway to community and culture, and a profound experience of beauty for adults and children alike. While the aesthetic value of song is vitally important on its own, science is also increasingly confirming the value of the act of singing. Researchers have shown that singing, particularly group or community singing, can provide a host of benefits to the singer, including a sense of increased well-being and joy (Judd & Pooley, 2014), meaningful social connection, feeling more energetic and positive, reduction of anxiety, and feeling spiritually uplifted (Clift & Hancox, 2001; Grape, Sandgren, Hansson, Ericson, & Theorell, 2002).

Participation in everyday singing should be an easy access point for lifelong musicking for almost all persons from early childhood to old age. However, the widely-accepted western cultural assumption that musical talent is reserved for an elite few may leave fewer and fewer persons feeling confident enough to sing with others (Sloboda, Wise, & Peretz, 2005). The joy, aesthetic experience, and host of other benefits of

singing, particularly of singing in community, are likely not experienced by individuals for whom a sense of inadequacy about singing competency leads to feelings of self-consciousness and deters them from singing (Abril, 2007; Phillips, 2014; Ruddock & Leong, 2005).

Are those individuals correct in their self-assessment? Research about singing competency in the general population has reached somewhat mixed conclusions. Some researchers have found adult singing accuracy to be not significantly different than that of kindergarteners (Demorest & Pfordresher, 2015). In contrast, other researchers have found that almost all adults can "carry a tune," but that many self-label as "tone deaf," even though only about five percent of adults truly have congenital amusia[2] (Dalla Bella, Giguère, & Peretz, 2007; Sloboda et al., 2005). Links between singing confidence and early musical experiences have also been found, as other studies have shown many adults who self-label as "non-singers" link those self-perceptions to childhood musical experiences (Demorest, Kelley, & Pfordresher, 2017; Stephens, 2012). Clear memories of a devastating "tone deaf" label, and negative experiences of singing in childhood, can influence future involvement in music (Demorest et al., 2017). It appears that musical self-concept[3], including one's perception of singing ability, can originate very early in life.

Statement of the Problem

Singing ability is "fundamental to developing musicianship and to the developing view of oneself as a musical being" (Welch, 2006). The earlier music educators can

[2] *Congenital amusia* is a musical disorder characterized by impaired pitch perception (Dalla Bella, Giguère, & Peretz, 2009).
[3] *Musical self-concept* can be defined as a person's perceptions and beliefs about his or her own musical abilities (Strong, 2012).

support and promote successful singing in developmentally appropriate ways, the better, as singing development begins in early childhood and a child's music teacher may be primarily responsible for their singing development (Hedden, 2012; Trainor, 2005; Campbell, 1999). If musical self-concept is shaped as early as elementary school, where many general music learning activities are based around singing, it is crucial to equip elementary general music teachers with knowledge of variables that may impact singing voice development. Successful singing in elementary school may inspire students to continue singing in community, as well. Demorest et al. (2017) found that a student's choice to enroll in secondary singing programs is likely influenced by their feelings of singing competency as they exit elementary general music programs.

Singing is an emphasized and widely used music activity in today's elementary music classroom (Orman, 2002; Phillips & Doneski, 2011) and the development of singing ability has been an important aspect of school music instruction since its very beginning in the United States (Flowers & Dunne-Sousa, 1990; Green, 1994). Singing performance objectives are a part of our National Core Arts Standards (2014). It seems that the prevalence of singing experiences in elementary music classrooms should allow many students to sing successfully. However, similar to research on adult singing competency, research investigating levels of children's singing voice use and pitch accuracy during elementary school years has produced inconclusive results. Some researchers have found many students able to access their singing voices (Cooper, 1995; Rutkowski & Miller, 2003), and others found most students in elementary school to be at best "uncertain singers" (Levinowitz, Barnes, Guerrini, Clement, D'April, & Morey, 1998).

In a comparison of similar singing accuracy data from separate studies with Kindergarten, sixth-grade, and college-age adult students, Demorest and Pfordresher (2015) found that growth in singing competency is likely more related to singing participation and experience than maturity. While there are important physiological aspects of vocal development and singing that change with maturity and differ by child (Trollinger, 2003) the skill development necessary for learning to sing needs to be guided by music teachers who are well-prepared with research-based, effective teaching strategies. Fundamental singing habits formed in early childhood can lay the foundation for later singing development (Trollinger, 2003); Rutkowski (1996) found that ineffective training may actually be prove harmful to children's singing voice development.

Elementary general music teachers are increasingly responsible for teaching children as young as three and four years old, as preschool is included more and more in public schooling. More than 50% of 3- and 4-year-old children are now enrolled in preschool programs, and 30% are enrolled in public preschool programs (U.S. Census Bureau, 2016). Music educators of young students are charged with carefully and efficiently guiding singing development within the context of classroom music experiences. Fortunately, for many years researchers have investigated singing voice development from a variety of angles to better understand how to support students' singing competency.

Previous research in children's singing competencies has described the National Core Arts Standards (2014) objective of performing music with "technical accuracy" with a variety of labels: singing competency (Mang, 2006; Welch, Sergeant, & White, 1995), singing ability (Atterbury & Silcox, 1993), singing "in tune" (Welch, Sergeant, &

White, 1997), singing or pitch-matching accuracy (Cooper, 1995; Demorest & Pfordresher, 2015; Flowers & Dunne-Sousa, 1990; Gault, 2002; Goetze, 1989; Green, 1990, 1994; Guerrini, 2006), and tonal achievement (Guilbault, 2004). Researchers have investigated various strategies and variables that may affect children's pitch accuracy and singing voice access and use. Some researchers have studied the effect of musical context, such as harmonic and root-melody accompaniment (Atterbury & Silcox, 1993; Guilbault, 2004), as well as unison versus individual singing (Green, 1994). Others have investigated various teaching strategies, such as vocal modeling (Green, 1990; Persellin, 2006; Rutkowski & Miller, 2003), song-teaching methods (Gault, 2002; Klinger, Campbell, & Goolsby, 1998; Persellin & Bateman, 2009), individual and small-group singing activities (Rutkowski, 1996), and gesture use (Liao, 2008; Liao & Davidson, 2007).

Additionally, some early childhood music development researchers have compared music acquisition to language acquisition in attempts to better understand music learning (Burton, 2011; Chen-Hafteck, 1997, 1999; Gordon, 2003). Of particular interest to the present investigation are studies that have examined the role song text may play in children's singing voice use and pitch accuracy, which also had varied results. In a study of preschoolers' song recognition abilities, Feierabend et al. (1998) found that after listening to eight unfamiliar songs many times over four weeks, children were more accurate in recognizing songs that had been presented with text. Because melodic recognition (not performance) was enhanced with the presence of text, it may suggest that children attend to text over melody when listening to songs.

Levinowitz (1989) found that children more accurately performed a song on a neutral syllable than with text but advocated for further research with a more developed rating scale. Rutkowski, who developed the Singing Voice Development Measure (SVDM) utilized in this study, concluded that while first-grade children did not perform significantly better on the SVDM when using a neutral syllable, there were individual children who scored as much as six points higher (on a nine-point scale) when singing on a neutral syllable (Rutkowski, 1998). Jacobi-Karna (1996), in an 8-week investigation of preschooler's song singing accuracy with either song text or neutral syllables, found no significant difference between the two treatment methods, but found that students who performed singing tests first on a neutral syllable and then with text achieved the highest scores.

Valerio, Reynolds, Bolton, Taggart, and Gordon (1998) assert that unless children are provided with a rich and varied exposure to music very early in life they become primarily preoccupied with language acquisition and suggest that some songs should be presented or taught without text. Children seem to enter school with a clear focus towards learning text in songs, but that focus is not necessarily matched by ability to learn and reproduce melodic components of the same songs (Welch, Sergeant, & White, 1998).

Theoretical Frameworks

Developmental Learning and Processing Theories

Music Learning Theory. In this study, developmentally appropriate practice for the intervention and weekly early childhood music learning classes was taken from the Music Learning Theory (MLT) of Edwin E. Gordon. Music Learning Theory is primarily concerned with describing how individuals learn music and develop the skill of

"audiation." Audiation is defined as "hearing and comprehending in one's mind the sound of music that is not, or may never have been, physically present" (Gordon, 2012, p. 389). In MLT, Gordon blends his extensive research and study of music learning processes with influences from language acquisition theory and the developmental theories of Piaget and Vygotsky. The music learning sequences include stages of generalization-based and inference-based learning; however, these stages are not highly specific to chronological age, as Gordon (2003) asserted that children construct their own understanding of music as they move through the types and stages of audiation.

The idea that a child can progress through the music learning sequences and stages of audiation is based on two interconnected premises: that all persons are born with some level of music aptitude, or potential to achieve in music (Gordon, 2003), and that audiation ability is developmental before age nine, and is highly affected by a child's music learning experiences, or lack thereof (Gordon, 2003). While studying music learning in three and four-year-old children, Gordon noticed that many children enter school with very little musical readiness for formal music classes. In response to this, he developed *A Music Learning Theory for Newborn and Young Children* (Gordon, 2003). In this work Gordon advocated that similar to language learning, children must be provided, from birth, with structured and unstructured informal guidance in music in order to build vocabularies in listening, speaking (singing), reading, and writing. Contained in this informal guidance should be rich music learning experiences that help children progress through the types and stages of preparatory audiation, which are shown in Table 1.

Table 1

Types and Stages of Preparatory Audiation

Types	Stages
1. Acculturation: Birth to age 2-4; participates with little consciousness of the environment.	1. Absorption: hears and aurally collects the sounds of music in the environment.
	2. Random Response: moves and babbles in response to, but without relation to, the sounds of music in the environment.
	3. Purposeful Response: tries to relate movement and babble to the sounds of music in the environment.
2. Imitation: Ages 2-4 to 3-5: participates with conscious thought focused primarily on the environment.	1. Shedding Egocentricity: recognizes that movement and babble do not match the sounds of music in the environment.
	2. Breaking the Code: imitates with some precision the sounds of music in the environment, specifically tonal patterns and rhythm patterns.
3. Assimilation: Ages 3-5 to 4-6: participates with conscious thought focused on the self.	1. Introspection: recognizes the lack of coordination between singing, chanting, breathing, and movement.
	2. Coordination: coordinates singing and chanting with breathing and movement.

For the purposes of the present investigation, I presumed that the preschool children being studied had already reached the imitation or assimilation stages of preparatory audiation, given their age range and participation in weekly music classes for

at least a semester prior to the study. However, because children's home music environments were likely different, it was possible that some students were still in the absorption stage or that some were potentially nearing their exit from preparatory audiation. While the weekly music classes were planned with the imitation and assimilation stages in mind, the music teacher for the study and I responded to children's unique levels of participation and development in ways appropriate to each child.

Gordon asserted that meaning is given to music through its syntax (organization and structure). To audiate the syntactic characteristics of a piece of music, children must be able to audiate the tonality and meter of that piece. I took care to ensure that the intervention and control groups in this study both received structured informal guidance that would support audiation development, particularly through the inclusion of tonal patterns as part of criterion song presentations. Developing vocabularies of tonal and rhythm patterns allows children to build musical memory and audiation from a foundation of imitation; Gordon suggested that children can imitate without audiating but cannot audiate unless they are first able to imitate (Gordon, 2003).

The task under examination in this study, singing songs alone and unaccompanied, could provide insight into whether a child has progressed beyond imitation toward audiation. In the imitation stage, children can "emerge from their musical egocentricity by discovering they can compare their singing or chanting with what another person is or is not performing" (Gordon, 2003, p. 35). The intervention being tested, exposure to without-text presentations of criterion songs prior to the addition of associated lyrics, was designed with consideration for the next type of preparatory audiation, "assimilation." Understanding the role song text may or may not

play in children's ability to imitate melodies with precision could help music educators facilitate young children progressing to greater levels of self-awareness and coordination in their singing.

Piaget's concept of "centration." I believe an additional rationale for continuing to investigate the effect of song text on children's singing accuracy is found in the idea that separating music and language stimuli may allow children to concentrate on a variety of basic music elements and build music vocabularies. Piaget, in his stage theory of child development, claimed that during the pre-operational stage (approximated between 2-7 years) intelligence is becoming symbolic and able to be expressed through language, imagery, and other modes, and in this stage becomes "uniquely human" (Bjorklund, 2012). But within this general stage of development, Piaget also described children's thinking as being "centered," where they make judgments based on the most salient aspect of their perceptual fields. This perceptual "centration" means that preschool-aged children can be highly attentive to certain aspects of a perceptual array and may often be unable to integrate the parts of the array into a whole.

While this stage theory may not be perfectly applicable to all aspects of developmental music aptitude and preparatory audiation, the possibility of some preschool-age children being unable to attend to multiple facets of a perceptual stimuli suggests that some children may have a difficult time attending to both the melody and lyrics of a song simultaneously. This possibility lends support to Gordon's assertion that young children should have the opportunity to build tonal and rhythm music vocabularies on neutral syllables, as well as to results of other studies that have shown children to recognize songs more by lyrics than by melodic content (Feierabend et al., 1998).

Patel's "Shared Syntactic Integration Resource Hypothesis." Piaget's concept of centration may also be supported by current neurocognitive theory about the syntactical processing of music and language in the brain. Rapidly growing interest in the cognitive and psychomotor processes behind accurate and inaccurate singing has led to an increase in research in those areas, and there are theories emerging about those processes from structuralist, cognitive, and developmental angles (Pfordresher, Demorest, Bella, Hutchins, Loui, Rutkowski, & Welch, 2015). While there is division in the fields of cognitive neuroscience and neuropsychology about whether music and language are processed separately or on a shared network (Patel, 2010), many researchers have found that in the earliest stages of language and music learning in infancy, speech and song perception and production do seem to overlap (Trainor, 2005).

A number of researchers have asserted that while retrieval of music and language may take place in separate neurological domains, evidence seems to point to there being shared networks for the syntactical processing of music and language, specifically in Broca's area (Kunert, Willems, Casasanto, Patel, & Hagoort, 2015; Patel, 2012). According to Patel's "Shared Syntactic Integration Resource Hypothesis" (SSIRH), this overlap in processing is the result of "overlap in the neural areas and operations which provide the resources for syntactic integration" (Patel, 2010). Songs require the simultaneous processing of both musical and linguistic syntax, and it is possible that if these processes neurologically overlap the resulting cognitive load may, for some children, impede the ability to sing songs accurately, even if their music perception abilities are satisfactory. As shown by emerging theories and research, song-singing is a

complex task requiring the coordination and integration of many cognitive and psychomotor processes from initial perception to production (Pfordresher et al., 2015).

Need for the Study

The ability to sing songs in tune is a valued form of musical achievement, and the development of this ability begins in early childhood, as a child's innate musicality is shaped by their musical experiences. According to Gordon, this innate potential to achieve in music (music aptitude) is only fully enabled through the development of audiation. In audiation, he says, we think and give meaning to music similarly to how we think and give meaning to speech (Gordon, 2003). Part of audiation is comprehending musical syntax. Singing songs with text requires simultaneous processing of musical syntax and linguistic syntax and may present a cognitive load challenge to some students as the brain areas responsible for these processing tasks seem to overlap. It is possible that some children focus on the text of a song as its most salient feature, and it may help build children's audiation ability and singing competency to provide separate opportunities to assimilate the melodic and text content of a new song (Welch et al., 1998).

To date, research investigating the effect of presence or absence of text on children's singing accuracy has been inconclusive and has involved singing tonal patterns or songs either entirely with text or entirely without text for the duration of the studies. Because singing songs with text may be more comfortable for many general music teachers, as well as more normative for many young students, this study was designed to further investigate the effect of the presence or absence of text on children's singing competency through implementation of a two-stage intervention, where participants in

the treatment group learned the melody of criterion songs on a neutral syllable prior to adding the associated text.

There is a continued need for greater knowledge of what constitutes developmentally appropriate instruction for young children's singing development, particularly for implementation by classroom music educators. Practically, successfully guiding large groups of young children through both preparatory audiation and early singing development necessitates strategies usable in minimal time and with maximum benefit for students at a wide variety of both musical and linguistic developmental levels. Because song singing is such a common activity in preschool music classrooms and general classrooms, increased understanding of how song text may affect children's accurate perception and production of songs could be of benefit to many music teachers who want, or need, to teach songs with text to their preschool students.

Purpose of the Study

The purpose of this study was to examine the effects of with-text and without-text song presentation styles on song-singing competencies of preschool children. The following research questions were developed for this study:

1. Does presenting new songs with or without text affect the singing voice use of preschool children during song singing?
2. Does presenting new songs with or without text affect the pitch accuracy of preschool children during song singing?
3. Are there any relationships between tonal music aptitude, song presentation style, singing voice use, and pitch accuracy in preschool children?

Definition of Terms

The following terms, as defined, were used in this study:

1. Audiation: "Hearing and comprehending in one's mind the sound of music that is not or may never have been physically present. It is not imitation or memorization. There are six stages of audiation and eight types of audiation" (Gordon, 2012, p. 389).
2. Criterion songs: Songs specifically used for data collection.
3. Developmental music aptitude: "Music potential affected by quality of environmental factors. A child is in the developmental music aptitude stage from birth to approximately nine years old" (Gordon, 2012, p. 392).
4. Music aptitude: "Potential to achieve in music" (Gordon, 2012, p. 404).
5. Musical syntax: "Orderly arrangement of pitches and durations in music. Music has syntax (context) but not grammar" (Gordon, 2012, p. 411).
6. Pitch accuracy: Measurement of the frequency of a child singing "correct" melodic pitches within the context of a criterion song; correct pitches are closer to the target pitch than the adjacent pitches, as measured in cents. For this study, the number of correctly sung pitches, per criterion song, was translated into a percentage score.
7. Preparatory audiation: "Hearing and comprehending music while in music babble stage as readiness for engaging in audiation. There are three types of and seven stages of preparatory audiation" (Gordon, 2012, p. 406).
8. Resting tone: "Sometimes referred to as a scale tone or a home tone. Tonal center or centers to which a piece of music gravitates. Resting tone is

specified by a movable-do syllable in the moveable-do system with a la-based minor. Tonality has a resting tone whereas keyality has a tonic" (Gordon, 2012, p. 407).

9. Singing voice use: For this study, assessed using Rutkowski's (1998) SVDM; a score reflecting how much a child is able to melodically use their voice above the typical speaking vocal register.
10. Song presentation style: A way of exposing children to a familiar or unfamiliar song.
11. Structured informal guidance: "Guidance that is based on a child's natural responses and a specific plan. It occurs in acculturation, imitation, and assimilation, specifically stages 3 through 7 of preparatory audiation" (Gordon, 2003, p. 121).

Assumptions and Limitations

This study was an efficacy (or intervention) study designed and conducted to understand the effects of the treatment when implemented under ideal conditions (Shadish, Cook, & Campbell, 2002). Weekly music classes at a local children's center provided the ideal conditions for this study, as the children's previous song-learning experiences at the center had been text-based, and the with-text presentation style could be assumed to be an appropriate control condition. Because preparatory audiation is developmental (affected by a child's music learning environments and participation) and somewhat subjective, I assumed that participants began the study at stages of preparatory audiation and language development that would allow them to take part in treatment and control singing activities. Participants' singing competencies and developmental music

aptitude levels were assumed to be normally distributed and homogenous in variance, and measurable with use of the SVDM, pitch accuracy analysis, and developmental music aptitude scores.

The limitations of this investigation include the study of a small, convenience sample and potentially lessened generalizability to student populations of socio-economic backgrounds different from the study participants. Participants' language acquisition levels were not measured in this study, and there may be disparities in language readiness between children from low socio-economic backgrounds and children from higher socio-economic backgrounds likely represented in this sample (Leffel & Suskind, 2013). Additionally, some participants may have been navigating the use of English as a second language, which may have also impacted their language readiness in the singing tasks.

Overview of Remaining Chapters

In Chapter 1, background information for the research problem, the theoretical bases for and need for the study, the research purpose, research questions, and hypotheses, and definitions, assumptions, and limitations relevant to the study were presented. In Chapter 2, related literature is reviewed, including research pertaining to (a) singing voice development and use, (b) pitch accuracy in children's singing, and (c) areas of potential overlap in music cognition and language cognition. In Chapter 3, the methodology of the study is described, including the research design, setting and sample, measures, and procedures for data collection and analysis. In Chapter 4, results and interpretations of the data analyses are presented, and in Chapter 5, these findings are summarized and presented with conclusions and recommendations for practice and future research.

CHAPTER 2

REVIEW OF RELATED LITERATURE

In this chapter, literature related to the present study is reviewed. The search for related literature was guided by the following questions:

1. What is known about how children learn to sing?
2. What is known about pitch accuracy in children's singing?
3. What research has been done regarding the effect of presence or absence of song text and children's singing competencies?

Searches were conducted utilizing Google Scholar and online university library databases including JSTOR, ERIC, and ProQuest Dissertations and Theses Global. Search terms included the following: children's singing; children's singing accuracy; children's singing competency; pitch accuracy; singing voice development; singing proficiency; music acquisition and language acquisition; music cognition and language cognition; and measuring singing accuracy.

The content of literature reviewed in this chapter is based around a main category of Children's Singing Accuracy, divided into relevant subcategories. The subcategories include (a) singing voice development research, (b) pitch accuracy research, (c) research specifically investigating the effect of song text presence in children's singing accuracy. Following the review, I have included a brief discussion of how the related literature informed the design of the present study.

Singing Voice Development

Researchers have explored facets of singing voice development for decades and have investigated the effects of a variety of learning contexts, teaching strategies, and other variables on children's general singing ability and development. Studies reviewed in this section pertain to those topics, as well as the topic of children's singing voice acquisition and use.

Development and Testing of SVDM

Rutkowski (1990) stated that it "seems logical that a child must gain use of the singing voice before intonation problems can be researched and evaluated" (p. 82) and sought to develop descriptions of child singing voice development that would include a rating scale and formulation of a consistent vocabulary. Prior to developing the *Singing Voice Development Measure* (SVDM), Rutkowski reviewed already existing rating scales for their usefulness in assessing only singing voice use (but not intonation) and found that those scales largely measured pitch accuracy or both elements, but not singing voice use alone. Following compilation of previous singing voice research and consultation with elementary vocal music specialists, she discerned five stages of development and created the initial SVDM (Rutkowski, 1986). Data from a pilot study, using a short, familiar song in minor tonality, showed the scale to be reliable and valid, and therefore an appropriate instrument for the measurement of children's singing voice use. After implementing a revised (more specific) version of the rating scale in a larger study utilizing both a short song and tonal patterns, Rutkowski again found the scale to be valid and highly reliable, but recommended several further revisions, including cutting the test procedure down to one subtest. Due to the high correlation of the song and pattern subtests, one subtest

would be sufficient; based on slightly higher gain scores and greater ease of administering and scoring of the pattern subtest, Rutkowski focused on revising and utilizing this subtest for future studies. Since the creation of the initial five-point scale, she has continued to further revise and expand the SVDM to increase rating accuracy and specificity. The current 9-point scale, used for the present study, is provided in Appendix A.

Levinowitz et al. (1998) examined several facets of Rutkowski's original SVDM for potential use in the elementary music classroom (Rutkowski, 1990). In this study, the researchers set out to assess the reliability of this measure for children in grades 1-6, to determine whether children's use of singing voice is developmental during those grade levels, to investigate the dependability of singing voice use when children are singing in major or minor tonalities, and to provide further understanding of the expectations for singing voice use in grades 1-6. The sample for this study was comprised of 170 students from five southern New Jersey elementary schools. The co-investigators were also the cooperating teachers, as they were both graduate students and full-time music educators. Students were randomly sampled from two grade levels at each school, and were taught two criterion songs, one in major tonality and one in minor tonality, for a month prior to data collection. Data collection was conducted during music classes, as students were accustomed to singing alone; the teacher established tonality and cued each student to begin by singing on the criterion song starting pitch and indicating the preparatory breath.

The collected recordings were compiled in a randomized order and were analyzed by the six co-investigators independently. Results included high inter-judge reliability for all grades except 6th grade, suggesting that perhaps a different rating scale should be used

for older students; the researchers found no statistically significant differences in children's use of singing voice from grades 1-6, and means from all grade levels aligned with the "uncertain singer" category in the SVDM. As many as 90% of the participating children's performances placed them in the "nonsinger" categories of pre-singer, speaking-range singer, and uncertain singer. The investigators asserted that these results point to singing being a learned, complex skill rather than developmental, and that it is highly important to teach singing through a systematic approach, particularly for underdeveloped singers. The SVDM was recommended for use in all elementary levels K-5.

Pedagogical Approach and Singing Voice Use

Harmonic Accompaniment. Atterbury and Silcox (1993) studied intact kindergarten classes and the influence of piano harmonic accompaniment on kindergartners' singing ability over one year of music instruction through a pretest-posttest control group design. All classes learned the same criterion song for three weeks at the onset of the study, which was used for both pretest and posttest, and all collected recordings were evaluated using a four-point scale adapted from Rutkowski's (1986) 5-point SVDM. The researchers also administered the Primary Measures of Music Aptitude (PMMA, Gordon, 1986) in the spring after finding that the kindergarten students' fine motor skills were inadequate for completing the test (which includes selecting a correct answer on paper) in the fall. Over the course of the year, the control group (n = 109) had music lessons including singing with piano harmonic accompaniment, and the treatment group (n = 96) had the same lessons without piano harmonic accompaniment. The researchers found no significant differences in singing ability between the two groups.

However, the researchers conceded that collapsing the rating scale from five to four points may have been a factor in the lack of differences in scores and recommended the use of an expanded scale in future studies. It is also unclear how often the criterion song may have been revisited and practiced over the course of the year. Posttest scores of participants with high music aptitude were found to be significantly higher than participants with average or low music aptitude.

Guilbault (2004) studied the effect of a root-melody accompaniment on kindergarten and first-grade children's tonal achievement and ability to vocally improvise, using criterion songs and improvisation tasks without text. Four classes of kindergarten students (n = 68) and four classes of first-grade students (n = 68) received 30-40 minutes of music instruction two times for every six days of school, and instruction was based largely in Music Learning Theory. Rote songs were taught and sung without text initially, and text added to some songs after children were able to sing the melodies accurately. Approximately two-thirds of the instructional time involved singing and included conversational improvisation with the teacher. Initial administration of the Tonal subtest of the Intermediate Measures of Music Aptitude indicated that the tonal aptitudes of control and treatment groups in the two grades were similar.

Over the course of the 25-week study, students in the treatment groups received song instruction with root melodies presented in a variety of vocal and instrumental mediums. Four weeks prior to the conclusion of the treatment period, all students learned two researcher-composed criterion songs, one in major tonality and one in minor tonality. Both songs were sung on the neutral syllable "bum," were equal in length, and had identical root melodies. Posttest performances included the children performing the two

criterion songs as well as improvising an ending to an unfamiliar song without text. No root melody accompaniment was provided. Children's performances were rated using a tonal achievement rating scale based on a 5-point scale created by Levinowitz (1987), and a similar 5-point, researcher-created improvisation rating scale. While Guilbault found no significant difference between the treatment and control groups, in the children's tonal accuracy achievement, the children who received song instruction with root melody accompaniment received much higher tonal ratings during improvisation tasks, particularly for the first-grade students in comparison to the kindergarten students.

Instructional Group Size. Rutkowski (1996) studied children's singing voice development, tonal music aptitude, and the use of individual and small-group singing activities with a total of 103 kindergarteners over the course of two school years. A pilot study was first conducted with 14 students over nine months and confirmed the usefulness of the main study as well as the necessary design, sample and procedures. The main study, a non-randomized control group pretest-posttest design, was designed to specifically investigate whether there would be differences between the control and treatment groups in tonal music aptitude (as measured with PMMA) after four and nine months of instruction, whether there would be differences in groups' use of singing voice (as measured with the SVDM) after nine months of instruction, and the strength of relationship between children's tonal aptitudes and use of singing voice.

Intact classes of kindergarteners (N = 99) were randomly assigned to either the control group or the treatment group; the content of music lessons was the same for both groups during the study, but the control group received large-group singing instruction only, while the treatment group also received small-group and individual singing

instruction. Participants received all music instruction from their regular music teacher for about 30 minutes, once a week. Before the treatment began, the music teacher administered the PMMA tonal subtest (PMMAT) as well as the SVDM to all students; the PMMAT was also administered at the mid-point and end of the study. The SVDM was administered prior to treatment and at the end of the study. PMMAT was scored and recorded by the music teacher, and two independent raters who had experience with the SVDM from the pilot study scored the participants' recordings, which were arranged by the researcher with posttests recordings first.

Rutkowski analyzed the data using two-way ANOVA, calculation of means and standard deviations, and ANCOVAs with pretest PMMAT and SVDM as covariates. No significant differences were found between groups' tonal aptitude scores, though both groups' tonal aptitude increased over the course of the treatment period. Significant differences did exist, however, between groups for SVDM on the posttest, with the treatment group means higher than the control group means for singing voice use. Individual and small-group instruction did appear to affect children's use of singing voice. An average child in the control group finished the study at the level of "speaking range/uncertain singer," while an average child in the treatment group finished the study at the level of "uncertain/initial range singer." The data also showed the relationship between PMMAT scores and SVDM scores to be very small. Rutkowski recommended that teachers not assume that a child's singing performance is indicative of their tonal potential in music, and that teachers should include individual and small group singing activities in their music lessons. As a result of rater observations that children seemed to fluctuate between levels on the SVDM, Rutkowski expanded the SVDM to its current

form, allowing raters to account for student fluctuation. This version of the SVDM is included in Appendix A.

Rutkowski and Miller (2003a) utilized the recommendations from the 1996 study, including the expanded rating scale, in a longitudinal study of children's singing voice use. Twenty-eight students participated during their first- and third-grade years, and twenty-five of those students participated through their fifth-grade year. All general music class lessons were taught by the same music teacher, once a week for 40 minutes, for all grade levels, and included large-group, small-group, and individual singing activities. The SVDM was administered by the music teacher at the beginning and end of each of the school years, and children sang the SVDM patterns on both texted and neutral syllables. The performances were rated during the summer immediately following the school year by two raters with prior experience with the SVDM. The raters did not know the ages or identity of the children they were rating, and also did not know the purpose of the study.

Statistical analyses of the data revealed significant differences in singing voice use for both texted and neutral syllables between the end of first grade and the beginning of third grade, and from the beginning of fifth grade to the end of fifth grade. The participating students made gains in mean singing voice use from "limited range singer" in first grade to "initial range singer" in third grade, and then moved between "initial range singer" and "inconsistent singer" between third and fifth grade. Standard deviations decreased over time, reflecting increased consistency in students' singing voice use over the treatment period, and 92% of students had progressed to "initial range singer," "inconsistent singer," or "singer" levels by the end of fifth grade. These results contrast

greatly with those of the Levinowitz (1998) study. Rutkowski and Miller concluded that in the context of general music classes including small-group and individual singing strategies, all children can be taught to use at least a limited singing range, and most students can be taught to use an initial singing range, and that more significant gains occur after first grade.

Teacher Feedback and Modeling. In another investigation related to their 1996 study, Rutkowski and Miller (2003b) examined the effects of teacher feedback and modeling on 38 first-grade students' developmental music aptitude scores, as measured with Intermediate Measures of Music Audiation (IMMA), and using of singing voice, as measured with the SVDM. Two intact classrooms of first graders were randomly assigned to the feedback/modeling treatment condition or the control condition; children in the treatment condition received specific feedback on their singing in large groups, small groups, and individually. The researchers administered the IMMA prior to the study (September), at the midpoint of the year (January), and at the conclusion of the study (May). The SVDM was administered prior to the start of the study and at the conclusion of the study.

ANCOVA with pretest IMMA and SVDM as covariates showed that the only significant difference between groups occurred on the IMMA tonal subtest at the midpoint of the study. However, after a closer look at the data, the researchers could see that more children in the treatment group improved than in the control group, and more children in the control group had scores decline than in the treatment group. Rutkowski and Miller concluded that teacher modeling and feedback when employing small group and individual singing instruction may not have added much to the opportunity to hear

one's own singing voice already provided in the smaller-group activities, but that teachers should still certainly give feedback to and model good singing behaviors for children.

Pitch Accuracy

While singing voice development is likely a crucial underpinning of successful singing, the idea of being a "good" singer is generally linked to being able to sing melodic pitches accurately and in tune. Not surprisingly, there is a wider breadth of existing research dealing with how to build and assess children's pitch accuracy. The studies reviewed in this section include investigations of teaching approaches, assessment tasks, and the role physical vocal development may play in being able to sing accurately and in tune.

Age-Related Studies

Geringer (1983) studied the relationship between pitch-discrimination and vocal pitch-matching abilities with 4- and 5-year old preschool children (n = 72) and fourth-grade children (n = 72). The preschool children were randomly selected from a large, diverse preschool, and the fourth graders were randomly selected from five different public schools. After three days building rapport with the participants, Geringer conducted testing sessions that included "same or different" pitch-discrimination (PD) responses to twelve tonal pairs and vocally pitch-matching (VPM) final tonic pitches of a simple, three-measure song pitched in C, E, and F# major.

After PD scores were calculated, the participants were assigned to high, middle or low ability-level groups based on PD scores, and differences between ability groups, and between age groups, were found to be significant. For VPM scores, there was a

significant difference between the age groups, with fourth graders much more accurate than the preschoolers; Geringer stated that these results should be interpreted with some caution, given the high variability in the preschoolers' scores. However, overall correlations between PD and VPM scores were low and not significant, and Geringer suggested that pitch discrimination and pitch matching may be two separate abilities, or that an increased relationship between the two tasks may come with maturation and training.

In an analysis of three data sets across development, where the studies used a similar set of tasks and identical scoring procedures, Demorest and Pfordresher (2015) compared singing accuracy data for 78 college-age adults, 55 sixth-grade students, and 77 Kindergarten students, and also explored efficacy of acoustic scoring for some singing tasks to see how well it mimicked expert judgment. While the data were from three different studies, procedures in each study were adapted from Pfordresher and Brown (2007), and all measured single pitch, interval pitch, and pattern pitch sequences of four notes. These pitch-matching tasks were sung by participants as echoes to a vocal model; participants also sang a familiar song from memory. Performances for matching tasks were scored acoustically into "cents relative," and differences between sung and target pitches became "pitch deviation scores." Pitch accuracy was not calculated by intervals as the goal of matching tasks was matching absolute pitch, and sung pitches were considered correct if sung within 50 cents of the target pitch. Scores for pitch accuracy were converted into error rates. Each performance was also scored by expert judges for correct or incorrect pitches. Familiar songs were scored using a sequential rating scale developed by Wise and Sloboda (2008).

The researchers used 3 x 3 repeated measures ANOVA for analysis of both deviation scores and error scores by age and task, and found significant main effects for age and task. Generally, results indicated that while singing skills improved from kindergarten to sixth grade, many developmental gains seemed to reverse from sixth grade to adulthood. Demorest and Pfordresher suggest that these results provide evidence against singing accuracy naturally improving with age, and that interpreted "in light of environmental constraints," singing development may be related to experience rather than general development, and declines if not maintained. Additionally, acoustic scoring of matching tasks was highly correlated with expert judgment and may provide educators with an approach that is more standardized, as well as largely automated.

As part of a longitudinal investigation, Welch et al. (1997) assessed 184 students on a variety of vocal pitch matching tasks during their first three years of school (ages 5, 6, and 7). The vocal tasks included pitch glides, single and multiple pitch patterns, and two test songs that were constructed to be within the "notational comfortable singing range," containing age-appropriate, accessible and gender-neutral lyrics, and comprised of similar melodic and rhythmic patterns. Singing tests were administered the week following last teaching session by a member of the research team who was familiar to the children; the vocal tasks and songs were recorded without the researcher giving a starting pitch and using microphone placed 15-20 centimeters below the child's mouth. The resulting recordings were divided among six experienced musician raters so that each response was rated three times using previously defined 7-point scale.

MANOVA were used to test for interaction effects. The researchers found that females and males were consistently close in pitch-matching ability, though girls

generally had greater means for song performance, and boys for responses to test items. Mean ratings for boys' song singing had declined linearly across all three years, and the researchers made very interesting speculations that boys' declining song-singing accuracy could perhaps be attributed to the association of song singing with predominantly female teachers, or that boys' lower vocal pitch accuracy during song-singing may be cultural in origin rather than biological.

Cooper (1995) investigated the effects of grade level, gender, and individual or unison singing on the Vocal Pitch Accuracy (VPA) of 169 first-grade through fifth-grade students from a large, urban elementary school. Participants sang one criterion melody pattern pitched between C#3 and F#3 on the neutral syllable "loo," echoing a recorded model of a 12-year-old boy's unchanged voice. The researcher practiced the task with each child; half of the students were recorded singing in unison with the model first, and half were recorded singing individually first. The recordings were analyzed for "five cent" deviations from pattern pitches, and the means of each child's deviations for the individual condition and for the unison condition became their VPA scores. The researcher utilized the "Visi-Pitch" program for recording analysis, and reliability was calculated for Visi-Pitch scores by a re-evaluating them six weeks after initial score, with a second rater. Results included large standard deviations and mean cent deviations, and both distributions were highly skewed toward low deviations, or accurate scores.

For the entire sample, VPA during the unison singing condition was slightly better than during the individual singing condition. Repeated measures MANOVA showed the only significant effect to be between-subjects for grades three and four, with fourth graders singing more accurately. Cooper speculated the 4-beat pattern, pitched

below the register shift, may have fallen within accessible short-term memory requirements and was in an accessible range for many students. Even so, only 48% of the sample were designated accurate singers; the data seemed to indicate that singing accuracy varied considerably within and between grade levels and that improvement may not occur in predictable patterns. There seemed to be no trend toward improvement in VPA over time, and no significant differences between boys and girls, suggesting that variability in VPA is not attributable to gender alone. Cooper also recommended future studies include a combination of objective measures, such as the Visi-Pitch readings, and subjective ratings of perceived accuracy, which may be more reflective of teachers' ratings during instruction.

Maintenance of Tonal Center

Flowers and Dunne-Sousa (1990) assessed preschool children's abilities to echo short pitch patterns in relation to maintenance of a tonal center in self-chosen and taught songs, as well as age differences in tonality maintenance and accuracy of echoing pitch patterns, age differences in vocal range, and the sizes of vocal ranges used for different tasks. The researcher spent four class sessions building rapport and teaching a target song to 3- to 5-year-olds ($N = 93$) from two preschools, and following those sessions, each child was recorded singing a self-chosen song, the taught song, and echoing 20 short pitch patterns. The pitch patterns had been recorded six pitch levels to accommodate different child vocal ranges. The recordings were assessed in the following ways: 1) number of total pitches correct within 50 cents of vocal model; 2) number of patterns sung entirely correctly; 3) number of patterns sung with correct intervals but incorrect pitch level; 4) number of patterns with correct melodic contour but incorrect pitches or

intervallic relationships. Regarding the maintenance of tonal center, the self-chosen songs were evaluated as modulating, somewhat modulating, or not modulating, and taught song tonality accuracy was assessed by calculating the relationship of reference pitches in each phrase, as well as a categorical modulation assessment.

Significant results included the tendency of 3-year-olds to modulate most, 5-year-olds next, and 4-year-olds the least. The researchers suggest that perhaps these results were partially due to the difficulty of self-chosen songs. No significant differences by age were found for the taught song. Possibly the most striking results were: 1) only 14% of the children began three or more phrases in the same key as the previous phrase; 2) only approximately one third of children in each age group started on the given tonic; and 3) that percentages of exact reproductions were very low, only 10-35%. Results showed a significant relationship between a child's tendency to modulate and to be able to echo pitches correctly, and vocal ranges were larger when echoing pitch patterns than when singing songs that demand the same range of pitches. This may suggest that the lower level of self-monitoring require in pitch-matching exercises, as compared to song-singing, may facilitate use of a more expanded vocal range. The researchers recommended that children be instructed in how to maintain a tonal center.

Group vs. Individual Singing

In a study with one hundred kindergarten, first-grade, and third-grade students from three demographically-varied elementary schools, Goetze (1989) compared the effects of individual and group singing on those students' pitch accuracy. After a single training session with the researcher, students were brought in groups of three students (combined to six for group singing conditions) to record both individually and as a group.

While students sang the entire four-phrase criterion song, only the second phrase was used for later evaluation. The pitch accuracy for each recording was determined using a visual display on a "Visi-Pitch" machine, which showed pitch values in Hertz. The performance score consisted of the subject's deviation from the model performance; a higher score indicated a greater deviation and greater inaccuracy.

Following varied analyses of the data, Goetze concluded that students sang more accurately in the individual condition than in the group condition, that third grade students sang the most accurately of the three grades, that the girls generally sang more accurately than boys, and that boys were more impacted by the presence of other voices in the group than girls were. Goetze cautioned that since the participants were not randomly selected, these findings may not be generalizable to all children, but that it may be that some children may first sing more accurately individually before being able to sing accurately in a group. Potential reasons for this might include a student being unable to hear their own voice in the midst of a group, or perhaps the accuracy level of the others' singing in the group. Children may not be able to attend to auditory feedback about their own singing if distracted by others' singing or other musical elements present. Finally, Goetze suggested that teachers be wary of premature labeling of students as monotone or inaccurate singers if the only context for evaluation is group singing.

Green (1994) also examined the effects of unison (group) and individual singing on the vocal pitch accuracy of 241 children in grades 1, 2, 3, and 5 at an inner-city elementary school. Participating students were taught the children's song "Bow Wow Wow," which has a range of D-B above middle C. In data collection sessions, students sang in groups of eight, with students recorded both four at a time and individually, with

the task presentation (group first or individually first) alternated with each group of four students. The researcher reviewed the song prior to each data collection session. Recordings were analyzed for both correct pitches and correct intervals; if the song was sung with correct intervals but incorrect pitch level, the student was given half-credit.

Green analyzed the collected the vocal pitch accuracy data with three-way ANOVA with repeated measures for grade, gender, and performance condition. Analysis revealed significant differences due to gender (females outscoring males) and grade level (fifth grade scoring highest, gradual improvement from grades 1-2 and 2-3, with 3 significantly better than 1), and performance condition. Despite the simple pentatonic framework of the taught song, out of 33 possible correct pitches, the mean score for group singing was 16.42 and individual singing was 13.83. There were also significant effects for performance condition and grade. Both conditions improved across grade levels, but students made much larger improvement in group singing than individual singing, so that the difference between group and individual singing was much larger for grade 5 than any other grade. Green speculated that the increased accuracy shown in group singing may have been a result of the students singing with other children, as opposed to matching an adult vocal model, and that the group size of eight children may have been more helpful to the students than a typical full elementary class or individual singing in both allowing students to hear themselves, as well as encouraging student vocal projection in the safety of the group.

Nichols (2016) similarly explored the effect of task demands on children's singing accuracy with 120 fourth-grade children from two public and four private elementary schools in the Pacific Northwest. Students sang in solo and doubled response

conditions for pitch-matching tasks including single pitches, intervals, and patterns, and also for a performance of the familiar song "Jingle Bells." This study served two purposes; while it did result in data on children's singing accuracy, it had been designed primarily to evaluate task discrimination ability and how many items are required for reliable summative assessment of children's singing voices.

Students sang either individually or with a prerecorded, adult female vocal; all pitch-matching tasks included five items, and each item was comprised of four notes. The song task was preceded with a starting note from a pitch pipe and instruction from the recorded model in when to start. Half of the participants began with the solo condition, and half with the doubled condition. Pitch matching was considered accurate if the participant sang closer to the target pitch than the adjacent pitch, which was determined using a plus-or-minus 50-cent threshold, and scores from pitch-matching and song tasks were all translated into a 0 to 1 scale for comparison. Nichols found this set of assessment tasks met satisfactory discrimination levels, and that a minimum of three items within each task are needed for valid assessment.

Results regarding singing accuracy included the following: 1) participants were significantly more accurate when singing in the doubled condition; 2) performance of single pitch and interval tasks were significantly more accurate than pattern and song task performances; 3) performance accuracy increased, and then decreased, across tasks; 4) while participation in private lessons led to more accurate performances overall, there were no significant task interactions for this variable. Singing solo songs and patterns were the most difficult for students, clearly so as the data showed that the most successful solo task was not as accurate as the least successful doubled task. Nichols recommended

scaffolding singing accuracy by utilizing doubled singing with accurate models and individual feedback, and suggested that fundamental aspects of pitch matching must be in place before one can successfully sing a song. Tonal memory and song complexity may each play a role in singing accuracy development.

Vocal Modeling

The effects of vocal model on children's pitch matching and accuracy have also been studied. Green (1990) examined the effects of female, male, and child vocal modeling with 282 children in first through sixth grade with regard to pitch accuracy, including analysis of incorrect sung responses to each model type. Students were familiar with Kodály-based instruction and therefore familiar with the (*sol-mi*) "stimulus interval," a descending minor third sung on G-E above middle C. Data collection sessions were conducted seven days apart to minimize the effect of tonal memory, and the vocal model order was the same for all students: female, male, child. Recorded responses were evaluated with a tuner and counted as correct if within 100 cents of the target pitch.

Green found a significant effect for vocal model, with the child vocal model eliciting the most correct responses, followed by the female model and then the male model. Incorrect responses were more likely to be sharp for the child model, and flat for the female and male models. First graders had the most incorrect responses, and Green suggested that the first-grade students' demonstrated difficulty in matching pitch lends support to the idea that pitch-matching proficiency is affected by maturation. Decreased pitch-matching accuracy in the sixth-grade subjects may have been the result of auditory processing or cultural rules and expectations.

Persellin (2006) conducted a controlled investigation of the effects of vocal modeling, musical aptitude, and home environment on the vocal pitch accuracy of 134 kindergarten students. Three veteran elementary music educators from two working-class, diverse schools were trained in process and strategies and taught three randomly selected classes 25 minutes a week for eight months. Each of the three classes had been randomly assigned to one of three teaching strategies: singing for the class, singing with the class, and singing both for and with the class. Data collection involved students performing items from the researcher's Vocal Accuracy Assessment Instrument; the eight, three-note items had been pulled from Rutkowski's 1996 SVDM, and children were awarded one point for each note correctly echo sung after hearing a recorded child vocal model. Additionally, parents filled out the Home Musical Environment Scale, and participating children were also tested for levels of tonal and rhythm music aptitude using the Primary Measures of Music Audiation (Gordon, 1986).

Means and ANOVA showed that vocal accuracy improved in all three groups, though no treatment had a significantly different effect than any other, and that home environment significantly affected the pretest to posttest score changes, even though the home environment variability was very small. Out of a possible 24 points, mean increases in accuracy were 3.8 for the "sing for" group, 5.69 for the "sing with" group, and 5.43 for the "both for and with" group. The cooperating teachers seemed to prefer the flexibility offered by the "both" strategy, as their documented self-assessments revealed frustration at being limited to one teaching technique.

Pitch Matching and Speech Characteristics

Trollinger (2003) conducted an extensive investigation of relationships among acoustical measurements of pitch-matching accuracy, speech fundamental frequency, speech frequency range, age, and gender in preschool children. Children ages 36-71 months (N = 70) from seven preschool centers in three geographical areas of the United States were engaged in speech and singing tasks designed to help answer the research questions. The speech tasks, developed by a speech therapist, comprised both spontaneous, conversational speech as well as directed speech; singing tasks included the echoing of three "do-re-do" tonal patterns, twice and in random order as an echo to a prerecorded child vocal model. The "low" pattern began on middle C, the "middle" pattern began on E above middle C, and the "high" pattern began on the G above middle C. Testing sessions took place with small groups of children in a quiet research room, and recordings were made in volunteer order and using a lapel microphone.

Recordings of speech and singing were analyzed with CSpeech acoustical analysis program. For speech recordings, Trollinger focused on vowel analysis for fundamental frequencies (14 samples from conversation and 4 from directed activity), including Mean Speaking Voice Frequency and highest and lowest fundamental frequencies for each child. Similar analyses were completed for singing recordings: pitches were analyzed for in-tuneness in Hertz and deviation scores were derived. Descriptive statistics, MANOVA, Pearson product-moment correlations, and multiple regressions were used for analysis to answer research questions.

Results of these analyses indicated that the location of the singing patterns in children's vocal ranges affected their singing accuracy. Participants were most

homogenous in singing accuracy for the lowest pattern and less so for highest pattern, often singing a half to a whole step below for lowest pattern and as much as several steps lower for the high pattern. Trollinger found a significant main effect for gender for the middle and high patterns, and increases in inaccuracy with higher patterns were more pronounced in boys than girls. A moderate but highly significant correlation was found between mean speech frequency and singing accuracy; the higher a child's mean speech frequency, the less out-of-tune middle and high patterns were sung. Mean speech frequency was the strongest predictor of pitch matching accuracy for middle pattern, and speech range was the strongest predictor for singing the high pattern accurately. Gender was a secondary predictor for both the middle and high patterns.

Trollinger suggested that the structure and function of the developing voice is a key factor in singing development, and that muscle strength and memory may require more time to develop for some children. As well, there may be overlap between a child's speaking and singing voice during development. This is possibly a result of singing along with or echoing vocal models who consistently sing too low, as well as social conditioning towards preference for lower voices that may encourage children to vocalize unhealthily. Resulting recommendations for practice included the use of technology for pitch assessment in conjunction with other vocal assessment strategies for consistency and clarity, and increased awareness that speech and singing habits form early.

To address skew towards English-speaking children in research on singing development, Mang (2006) investigated the effects of age, gender, and language on the singing competency of Cantonese monolingual and English bilingual children, motivated by the belief that use of tonal languages may impact children's singing behaviors. Mang

also believed that findings from pitch-matching tasks could not necessarily be generalized to song-singing tasks, and so utilized both the Vocal Pitch Matching Development (VPMD) scale (Welch, 2000) and Rutkowski's (1998) SVDM for criterion song-singing tasks. Children aged 7 and 9 years (N = 120) from Hong Kong individually sang "Happy Birthday" in English, and their recordings were analyzed by two independent judges using the VPMD and SVDM. All recordings received a total of three scores, one for each individual scale as well as a composite score, and the scales were found to be moderately correlated. Results of ANOVA showed significant effects for gender and language but not for age; girls consistently outperformed boys, and the Cantonese children consistently outperformed the Bilingual children. Mang asserts that given the simple text of the criterion song, these results suggest that contrary to previous research findings the cognitive load presented in song text may not be responsible for singing differences between girls and boys. In contrast, the more accurate performances of the Cantonese speakers support previous hypotheses that native speakers of tonal (pitch-based) languages may acquire singing voice use earlier than those who do not speak tonal languages.

Song Acquisition Pedagogical Approach

Klinger et al. (1998) found that previous research regarding children's song acquisition indicated that children often learn the music of their culture by "immersion," a combination of listening to and experimenting with the music that surrounds them. To test this as it related to song acquisition happening within music classrooms, they investigated two instructional procedures: phrase-by-phrase, generally considered the traditional rote song procedure of building parts into a whole, and immersion, where the

song is always presented in its entirety. The researchers met with 39 second-grade students in two classes for two class sessions. The first session served as an introduction and a "pre-screening" for singing capability and willingness to participate, and the second session as the treatment and data collection. The students all learned two criterion songs that were in the key of D and limited to a vocal range of a perfect fifth, from D immediately above middle C to the A one fifth above. One song was taught with phrase-by-phrase instruction and one song with immersion instruction, and the treatment order was counterbalanced between the two groups. A week after the treatment session, children came in small groups to review the songs (without the help of the researchers) and then be recorded individually.

Children's recordings were evaluated by two experienced music teachers for pitch, rhythm, and text errors. The researchers used a Wilcoxon Matched-Pairs Signed-Ranks Test to discern differences by teaching method and found that while the children learned the songs through both methods, the immersion method led to significantly fewer performance errors across both songs than the phrase-by-phrase method. Initial phrases were more accurate than later phrases in both methods. These results were particularly interesting given that the children's regular music teacher normally taught with the phrase-by-phrase method. Klinger, Shehan, and Goolsby suggested that the phrase-by-phrase method may have disrupted the musical flow of the songs, potentially limiting the children's cognitively connecting the phrases, while the immersion method may have enhanced continuity and improved their overall performance. They also recommended future research with larger and more age-diverse samples, as well as with songs that exceed four pitches.

In a follow-up study, Persellin and Bateman (2009) also analyzed the effectiveness of these two song-teaching methods, though they labeled the immersion method instead as "holistic." This study, based off the Klinger et al. (1998) study, included first-grade students instead of second-grade students, different folk songs, and expanded the treatment time from one to three days to account for the younger age of the subjects. Treatment, data collection procedures, and analysis were the same. The researchers again found that children made fewer errors in songs taught with the holistic method, but this time found the difference to not be significant. Though pitch errors made up the greatest percentage of errors, rhythmic accuracy was the strongest predictor of overall accuracy. The researchers stated this may support theories that children learn songs by learning rhythms and words first, then pitch contour and intervals, and then key stability. Similar to the previous study's results, initial phrases were more accurate than later phrases in both methods.

Daily Singing Instruction

To determine the effect of frequent, focused singing instruction on children's singing accuracy, Demorest, Pfordresher, and Nichols (2017) compared pretest and posttest singing accuracy scores for a treatment group of 41 kindergarteners to a control group of 38 kindergarteners after a 7-month treatment period. The treatment group received daily, Kodály-based music instruction that prioritized singing development, while the control group received no singing instruction. Children in both groups were pretested on single-pitch, interval, and pitch pattern singing tasks, as well as a familiar song singing task "*Twinkle, Twinkle Little Star*"; after seven months, the students were posttested on the same exact tasks. Pitch-matching tasks were scored by determining the

proportion of pitches that fell within a +/- 50 cents range; the researchers scored familiar song accuracy on a separate 8-point scale (Wise & Sloboda, 2008), and scores did not depend on exact pitch accuracy but were based on children's ability to stay in tune with themselves. Sixty out of seventy-nine initial participants completed both the pretest and posttest recordings.

The researchers analyzed data for the pitch accuracy tasks using 2 x 3 x 2 factorial ANOVA including time and task as within-subject variables, and group as a between-subject variable. They found a significant main effect for time, a significant time x group interaction in favor of the experimental group, and a significant main effect for task type, with the interval task scores significantly better than the pattern task scores. The familiar song analysis, a 2 x 2 factorial design, showed that the experimental group slightly increased in accuracy from pretest to posttest while the control group slightly decreased in accuracy, but that group differences were not statistically significant. Moderate but significant correlations between song accuracy and pitch-matching accuracy were found for both the pretest and posttest.

Demorest, Pfordresher, and Nichols suggested that the data show young children's singing accuracy can be significantly aided by daily singing instruction, but that improvement may not be seen across all tasks; because some students achieved perfect scores both at pretest and posttest, it is possible for students this young to perform at a high level, and some may benefit from specific attention to singing skills. The importance of task to singing accuracy seemed to indicate that teachers and students would be best served by the inclusion of multiple measures of singing performance when evaluating children's singing. Song-singing, in this case from memory, was particularly

difficult for the children and showed no measurable improvement over the seven months. The researchers suggest that "given the central role of song singing in elementary music, the development of song singing accuracy merits more study with careful attention to task parameters" (p. 9). They also acknowledge that they were unsure whether demonstrated gains were the result of instruction frequency or the specific focus on singing skills, and recommend future research investigate whether the gains would continue over a longer treatment period.

Impact of Song Text on Singing Accuracy

Studies specifically examining the effects of song text on children's singing accuracy are more limited in number, though some researchers have included this topic as a part of a larger study (Gault, 2002; Rutkowski & Miller, 2003b). The following studies deal with the presence or absence of song text from a variety of directions, including melodic recognition, children's singing accuracy, and adult singing accuracy.

In a study with 35 children ages four to five years, Levinowitz (1989) investigated whether children performed rote songs with words more accurately than rote songs with words. Children in two intact classes received music instruction from the investigator once a week for five months, and during the weekly 30-minute lessons, half of the rote songs were taught with words and half were taught without words. In month five, Levinowitz taught the children in both classes two criterion songs, similar in melodic and rhythmic content, one with words and one on the neutral syllable "bum." At the conclusion of the month, children were recorded singing the criterion songs, and researcher-constructed tonal and rhythm rating scales were used to assess the children's performances. Children were also given the Peabody Picture Vocabulary Test to assess

their language development. Correlated sample t-tests were used for analysis, and while no differences were found between the conditions for rhythm, Levinowitz found that children more accurately performed a song on a neutral syllable than with text. Based on my visual inspection of the two criterion songs, the results may have also been affected by the somewhat more accessible range and melodic contour of the criterion song sung without text. The two songs were similar enough that they may have also been easily confused by the preschool-aged participants.

Welch, Sergeant, and White (1995, 1998) further analyzed the data from the previously detailed longitudinal study of 5-, 6-, and 7-year old children to provide specific insight into the role text may play in children's song acquisition. The analysis, which included comparison of mean word accuracy and mean pitch accuracy scores for the "task songs" taught each year of the study, revealed that the judges rated the children's ability to reproduce the words of the songs very highly in all three years, and that for each year the word accuracy ratings were significantly better than the pitch accuracy ratings. The children's melodic pitch accuracy ratings showed no significant improvement until approximately age seven, and even this gain was significantly lower than their word reproduction accuracy. The researchers determined that while children seem to enter school with an ability to learn the words of songs, their ability to learn this text seems to be far ahead of their ability to learn the melodic contour and intervals within those same songs. They also speculated that as spoken language has "primacy" in the development of preschool-aged children, young children may be biased towards words of songs; the data also showed that the children were much more pitch accurate singing when the simpler, deconstructed tasks (matching simple patterns, glides) related

to the songs. Welch et al. suggested that teachers may have greater success with supporting children's singing accuracy if song melodies and texts are taught separately.

Jacobi-Karna (1996) also studied whether children would sing more accurately when they are taught songs with original text or on a neutral syllable. Children who were three to five years old (N = 83) and enrolled in area preschools were randomly assigned to groups; the groups were then randomly assigned to either the Text Method or the Neutral Syllable Method treatment conditions. Participants in the Text Method groups were taught all songs with text, and participants in the Neutral Syllable Method groups were taught all songs on neutral syllables. After eight weeks of two 30-minute music and movement classes per week, the children were administered the Singing Accuracy Test as a posttest, followed by a second posttest in week twelve. Both posttests required the children to echo sing a test song in phrases and then sing the entire song. During week eleven, the children were presented with the test song in the opposite condition.

Data were analyzed using ANOVA, t-tests, and Newman-Keuls Post-Hoc Comparisons, and the researcher found that there were no significant differences in scores for singing accuracy between the instructional methods for either phrase-by-phrase or whole-song singing. However, results showed a close-to-significant interaction for the method of instruction and time of test, as the 4-year-old neutral syllable group's mean score increased considerably on the second posttest. From this data, Jacobi-Karna stated that teaching songs on a neutral syllable first and adding song text later seemed to be effective in improving young children's singing accuracy. Because the 4-year-old children in the text groups scored much higher than the 4-year-old neutral syllable group on the first posttest, it may also be that singing songs with text is helpful to 4-year-old

children. Lastly, it was recommended that children's singing accuracy be tested in two-measure phrases instead of using an entire song.

An examination of the effect of presence or absence of song text on kindergarten and first-grade students' song performance accuracy was part of Gault's 2002 study, which also included analysis of song-teaching approach and developmental music aptitude. This study, also in many ways a follow-up to the Klinger et al. (1998) study, used the same two pentatonic folk songs with 112 Kindergarten and first grade students. The songs were taught and performed without accompaniment, and all sessions were led by the students' regular music teacher. The four kindergarten classes and four first-grade classes were randomly assigned to one of four treatment groups that combined one song-teaching approach with one text presentation style. One song was taught during the first 4-week treatment period, and the other was taught during the second 4-week treatment period. Prior to the study, students were given the PMMA; children's individual singing recordings were collected during the last week of the second 4-week treatment period. Three trained raters, who were local elementary general music specialists, evaluated the recordings first for tonal achievement and then for rhythmic achievement. These scores were analyzed along with PMMA scores in a four-factor (2 x 2 x 2 x 2) mixed design.

Gault found that the two-way interactions Song X Text Condition and Song X Pedagogical Procedure were statistically significant, and that tests of simple effects showed a significant difference in favor of the with-text condition and in favor of the echo-phrase procedure for one song, but not for the second song. Main effects for Aptitude and Text Condition between-subjects effects were also statistically significant, with high-aptitude students achieving significantly higher than low-aptitude students.

Gault determined that given the mixed results of the study, educators should analyze the different songs they need to teach for rhythm, melody, and text and choose song-teaching procedures on a case-by-case basis rather than subscribe to one ideology.

Feierabend et al. (1998) investigated the effect of the presence or absence of song text on preschoolers' ability to recognize song melodies, specifically whether listening to songs over an extended period of time would contribute to greater integration in memory of words and music among preschool children. The researchers manipulated the manner in which songs were presented to 75, 3- to 5-year-old children to discern whether repeated listening to melodies without text and with text contributed to greater song recognition. The participants, who all came from middle-to-upper-income families, were randomly assigned to one of three treatment conditions, and listened to eight unfamiliar songs fifteen times over the course of four weeks.

Treatment A participants heard each song twice during listenings, both times with text; treatment B participants heard each song twice, once with text, and once without; treatment C participants heard each song twice during listenings, both times without the text. All songs were original compositions to ensure participants had no familiarity with the song content, and all song were accompanied by representative picture book stories. Four songs had closely related melodies, and four songs had melodies that were unrelated to any other song.

During data collection, the children listened to the songs in random order, with randomly arranged story pictures in front of them to point to as the means of identifying the song they thought they were hearing. To help isolate the task of melodic recognition, all songs were played on a neutral syllable. Results of data analysis indicated there were

no significant differences for age or gender. Mean correct response scores were low. Interestingly, children were significantly more able to recognize songs from the "unrelated melodies" set, as well as more accurate in recognizing songs that had been presented with text. The researchers suggested that perhaps melodic recognition could be enhanced by the presence of song text. I would add that these results may support the hypotheses that attending to words of songs might first be easier for children than attending to the melodic content.

Related Literature and the Present Study

The studies reviewed in this chapter greatly informed or affirmed the design of the present study, including the musical content and length of the criterion songs, the content of the weekly early childhood music classes, the data collection schedule and processes, and the measurement tools selected. Specifically, it appears that more research is needed in the area of the effect of song text on children's singing voice use and pitch accuracy using both a detailed rating scale and acoustic technology, and in a way that exposes children to melodic learning both on neutral syllables and with song text. Detailed information about the design of the present study is given in the following chapter.

CHAPTER 3

METHOD

The present study was designed to examine the effects of with-text and without-text song presentation styles on the singing voice use and pitch accuracy of preschool children. This chapter outlines the following components of the study: (a) general research design, (b) setting and sample, (c) dependent and independent variables, (d) validity, (e) procedures, and (f) analysis.

Research Design

A quasi-experimental, non-equivalent control group pretest-posttest design was used for the study. The participants (N = 39) were students attending half-day or full-day preschool at a university children's center in the Mid-Atlantic region of the United States. Because the participants could not be individually randomly assigned to conditions, I randomly assigned intact classrooms to either the control or treatment condition. All participants experienced weekly group music classes during the study comprised of a variety of music and movement activities, including song singing. Participants in the treatment group (n = 19) experienced learning two criterion songs first without the associated lyrics, with lyrics added later in the study. The control group participants (n = 20) also learned the two criterion songs, but with the associated lyrics throughout the duration of the study.

Setting and Sample

The participants for this study were preschool children (N = 39, 19 boys, 20 girls) who were part of mixed-age, 3- to 5-year-old preschool classrooms in an on-campus

children's center at a large Mid-Atlantic university. Four of five participating classes attended full-day preschool, and one participating class attended half-day preschool. Children in these classes were three or four years old as of September 1, 2016, and classes were organized prior to the start of the school year to be balanced in age and gender of students. Students' daily learning consisted of a variety of hands-on learning experiences, and they had been receiving weekly music lessons with a different music teacher prior to the semester of the present study. The weekly, 30-minute music classes and large-group sing-along times the teacher provided consisted of guitar-accompanied song singing and various other music and movement activities, including singing games, beat-keeping activities, playing small, non-pitched percussion instruments, and the use of movement-facilitating props like hula hoops and a parachute.

This music teacher received an opportunity to travel, and prior to my research inquiries the children's center director hired a senior vocal/general music education major from our university to be the new music teacher for the spring 2017 semester. Fortuitously, this young woman had been a student in my general music methods class and was delighted to work with me as both a mentee and co-teacher for this study. The ensuing partnership provided an ideal teaching environment for both the music classes and the research tasks required. I planned and structured each lesson very thoroughly to maximize consistency; however, having two teachers present for almost every class facilitated more opportunities for modeling vocal interactions, as well as greater attention and reaction to participants' spontaneous contributions, creating a learning atmosphere that felt informal, playful, and engaging. I was also able to conduct pretesting sessions with participants from other classes as my co-teacher continued with our regular weekly

schedule, allowing me to comply easily with the center's weekly allotted research times and still gather data from all participants within one week.

To build rapport, approximately a month before the start of the study the new music teacher and I began teaching the weekly music classes for all students at the center. These 30-minute classes consisted of music and movement activities that used songs, chants, and listening pieces in a variety of tonalities, meters, styles, and tempi. The classes followed the same structure used for classes during the study but did not include the criterion songs or any use of the no-text treatment condition that would later be investigated during the study. Most of the songs, chants, and movement activities for the pre-study classes and the entire semester were drawn from *Music Play* (Valerio et al., 1998), a compilation of songs and chants designed to facilitate early childhood musical development. To keep the no-text treatment condition isolated to the timeframe of the study, I added lyrics to some songs and chants that had originally been provided in *Music Play* without words for the classes preceding the study.

During these pre-study weeks, the children became familiar with both the new music teacher and me, allowing musical interactions to become comfortable and informal. I was careful to maximize the pedagogical usefulness of these weeks, utilizing these music lessons to familiarize the participants with tasks similar to those they would encounter during the test of developmental music aptitude, refresh their familiarity with the pretest song, and develop a happy association with our plush turtle "Largo," which would serve as a companion in the research room. The established rapport also allowed me to administer pretests at the start of the study as a familiar and friendly teacher rather than a stranger, and allowed the incorporation of the treatment and control conditions of

the formal study to blend in with an established set of music learning activities and routines.

All children in the five classrooms participated in weekly music classes and data collection sessions to minimize participation bias. To make possible nearly-equal participant numbers in the control and intervention groups, I needed to combine participants from three classes into one group (n = 19), and participants from the two other classes into another group (n = 20). Using a coin toss, the combined three classrooms were randomly assigned to the intervention group, and the combined two classrooms were randomly assigned to the control group.

Weekly music classes both before and during the study took place in the center's "great room," a large, carpeted, centrally-located open space, for most weeks of the study. Occasional classes were taught in regular classrooms when inclement weather necessitated the great room be open for other large-group movement activities. While movement components were slightly adapted to fit the different spaces on these occasions, the content of the music and movement lessons remained the same.

Independent Variable

The independent variable for the present study is criterion song presentation style, specifically the presentation of songs to children with text or initially without text. The label of "presentation style" was purposefully chosen to designate the difference in song content being shared with the participants, as opposed to a difference in teaching technique. Additionally, covariates of music aptitude scores as determined by the "Audie" test of developmental music aptitude (Gordon, 1989) and baseline singing

competency scores as determined by a pretest performance of a familiar song are discussed below.

Criterion Song Presentation Style

The investigation of the effect of criterion song presentation style took place within the context of weekly, informal early childhood music and movement classes previously described. Prior to the study, the researcher composed two 16-beat songs to be used specifically for data collection; these criterion songs are found in Appendix B. Throughout the length of the study, the five intact classes of preschool students were taught the two criterion songs repeatedly during the weekly classes, with each song presented four times per class using a planned combination of immersion and phrase-by-phrase teaching approaches. Because these songs were composed for the study, they were not familiar to the children. Care was taken to ensure the melodies fit with research-based recommendations for developmentally appropriate vocal range, length, complexity, and for similarity to songs and tonal patterns used in previous research (Atterbury & Silcox, 1993; Demorest & Pfordresher, 2015; Rutkowski & Miller, 2003b), including review of the composed melodies by Rutkowski via email correspondence (Rutkowski, personal communication, February 2017).

The criterion songs were presented to the children either with or without text depending on the status of the class as an intervention group (initially without text) or control group (always with text) and the current week of the study. For the first six weeks of instruction, intervention-group classes were taught the criterion songs without text; the songs were heard and sung on a neutral syllable. For the remaining five weeks of instruction, intervention-group classes continued to learn the criterion songs, but with the

associated lyrics added to the melody. This two-stage approach was chosen for this study over a strict text/no text comparison because of its potentially greater ecological validity, as school music teachers may be either expected to teach preschoolers songs with words or may not yet be comfortable with the idea of teaching songs entirely without words in their classrooms. Control-group classes were taught the criterion songs with text the entire eleven weeks of instruction. To control for order effects and prevent any heightened awareness of the criterion songs in comparison to other portions of the lesson, the criterion songs were carefully placed at different times within each week's lesson plan and taught with the same informal approach as the other songs and chants contained in the lesson. The tonal center of all songs was maintained within and between classes through the use of a resonator bell for establishing tonic pitches. All classes received the same lesson within a specific week, and the plans were carefully designed to isolate the experimental treatment. All other songs and chants included in the lessons were taught with lyrics for the duration of the study to match the control condition, so that only the criterion songs were presented differently to the control and intervention groups. The weekly plans can be found in Appendix C. Notation for the non-criterion songs and chants taught during the study can be found in Appendix D.

Dependent Variables

The dependent variables for the present study were the level of a child's singing voice use as measured with the SVDM (Rutkowski, 1998), and a child's pitch accuracy percentage score. Related and somewhat interwoven, scores for these two variables provide a detailed picture of singing competency. Descriptions of and rationales for these variables are provided below.

Singing Voice Use

The measurement of singing voice use is particularly helpful to this study because of the insight it provides regarding children's abilities to produce melodic vocalizations above the speaking voice range, and with what amount of consistency they do so. Researchers have found that young children sing most easily and naturally in the range of D3-A3[4] (Rutkowski, 1990). Successful acquisition of this initial singing range seems to indicate that the child has both the perceptual ability and vocal production (psychomotor) ability necessary to use a higher, melodic singing voice instead of a lower, chanting speaking voice, and children may access this initial range partially or in full as their singing voice use develops over time (Pfordresher et al., 2015). For this study, I used Rutkowski's (1998) SVDM to assess each child's singing voice use and assign the associated numerical score. The SVDM has been found to be a reliable and valid measure of children's use of singing voice (Rutkowski, 1990; Levinowitz et al., 1998), and allowed raters to assign numerical scores to the participants' song-singing performances.

The criterion songs for this study (Appendix B) were composed to encourage use of the initial singing range (D3-A3) as well as the lower end of the extended singing range (B-flat3 and above) as indicated by Rutkowski. Each child's SVDM score was determined by three independent raters listening to the recordings; I averaged the three ratings for each recording to restore the score to fit the SVDM scale. Ratings were also confirmed with the use of Adobe Audition CC (2017) software. This software provided visual representations of each child's recorded performances and displayed pitch targets, which allowed me to confirm singing or speaking ranges heard in the recordings.

[4] The D immediately above middle C to the A in the same octave.

The Adobe Audition CC 2017 software was also utilized to determine each child's pitch accuracy score. Realistically, a child's ability to access their initial and extended singing range was a prerequisite for achieving high pitch accuracy scores for this study's criterion songs; however, use of initial and extended singing ranges does not guarantee pitch accuracy, which is why pitch accuracy is included as a second dependent variable in this study.

Pitch Accuracy

If the presence or absence of lyrical text in a song might affect a child's use of singing voice, it might also affect a child's pitch accuracy when singing. Pitch accuracy percentage scores were determined by assessing whether the child sang a given pitch within the criterion song melody more closely to the target pitch than the neighboring pitches, or within 50 "cents" of the target pitch. Percentage scores were calculated by dividing the number of correctly sung pitches by the total number of pitches in that criterion song.

To assist the children in beginning each song performance for data collection, the researcher replicated the in-class routine of sounding the tonic pitch (D3) on a resonator bell, singing a preparatory sequence in the major or minor tonality of the criterion song, and singing "Now you sing" on the descending tonic triad for that song. Full data collection procedures can be found in Appendix E. When a child started singing a criterion song on a different tonic than the D3 provided to start, but otherwise sang the melody correctly, the pitches were still assessed as inaccurate.

Covariates

"Audie" Test of Developmental Music Aptitude

Audiation is defined as "hearing and comprehending in one's mind the sound of music that is not or may never have been physically present (Gordon, 2012). Music aptitude, also as defined by Gordon (2012), is "the potential to achieve in music." Audie (Gordon, 1989) is an assessment of audiation and music aptitude, and is a game-style predecessor for more formal tests of audiation and music aptitude such as the Primary Measures of Music Audiation (Gordon, 1986). Audie was specifically designed for use with preschool children who are three or four years of age and has been found to be a valid measure of preschoolers' developmental music aptitude (Taggart, 1994). Through a series of recordings, children heard that "Audie" is a character with a two-beat "special song" that becomes the basis for musical comparison: the children were asked to compare a variety of two-beat "songs" to "Audie's song" and indicate whether the new song was the same as Audie's song, or different.

This assessment is divided into a melody section and a rhythm section, each with ten questions, to facilitate separate testing of tonal and rhythm aptitude as well as make the game sections of a reasonable length for a preschooler's comfort and attention span. For this study, I administered only the tonal section of Audie (Audie-T) in one-on-one sessions with each child during the first week of the study, as tonal audiation ability is the most relevant to the song-singing task under investigation. Audie-T testing sessions were held in the children's center research room, a smaller and separate room that is designed for small group and quiet activities. I approached giving directions for the game light-heartedly and as "needing help" from the child to answer the musical questions. The

children were given the opportunity to hold a special stuffed animal during the session to maximize comfort. No other incentives were given for participation in the assessment, per the children's center policy. I documented each child's answers on given score sheets as part of the game, and later transferred those scores to my computer. In order to answer the secondary questions of the study, including determining potential relationships between Audie-T scores and singing competency, participants' Audie-T scores were included as covariates in the final analysis.

Baseline Singing Competencies Assessment

To control for children's prior level of singing voice use and pitch accuracy, during the second week of the study the researcher recorded each child individually singing the familiar song "*Twinkle, Twinkle, Little Star*." This song was selected for its familiarity, its range of a major sixth, which when begun on D3 requires children to sing above the "lift" (to B3), and simple contour. These recordings were completed and evaluated for singing voice use and pitch accuracy using the same procedures as described in the following section. While it did not test the same material as the posttest, this pretest singing assessment provided useful data about each child's singing competencies when singing a song with text if the song had been heard many times and was familiar, as the criterion songs would be by the time of posttest data collection. Baseline singing competency scores were included as covariates in the final analysis.

Assessment of Validity

In the following section, the internal, external, and ecological validity of the study are examined. Internal validity is defined as "the validity of inferences about whether the relationship between two variables is causal" (Shadish et al., 2002). External validity is

defined as whether an observed causal relationship "holds over variations in persons, settings, treatment variables, and measurement variables" (Shadish et al. 2002). Ecological validity is a determination of how well the research settings and samples reflect the "ecology of application" (Shadish et al, 2002, p. 37).

Internal Validity

Treatment and data collection. The aim of this research was to discern any effect the presence or absence of lyrical text in taught songs may have had on preschool children's ability to learn and accurately sing melodies of simple songs. The evaluation of recordings of participant children singing simple songs was therefore the most valid assessment for this research question, but these recordings would have been of little value had the criterion songs been unequally familiar to the children. For this reason, it was necessary to present criterion songs that were original and consequently unfamiliar to all participants in both the treatment and control conditions, so that all participants would have a similar level of exposure to the criterion songs. Additionally, all other plans for the music lessons were identical for all classes during each week of the study. Isolating data collection to new songs presented only through the treatment and control conditions provided greater assurance that children's performances would be reflective of their performance of other unfamiliar simple songs taught in these conditions within a music classroom.

Measurement. The goal of helping young children learn to sing melodies accurately is predicated on helping them successfully access, and choose to use, a melodic singing voice instead of a chant-like speaking voice. Because prior research has suggested children's gravitation toward song text may cause them to choose lyrical

accuracy over melodic accuracy (Welch et al., 1998), it was both necessary and useful to measure the participant's singing voice use with the SVDM. This measure allowed me to not only determine if pitches were correct or incorrect, but whether each child performed within a singing or speaking voice range. From there, I was able to discern an even fuller picture of singing competency for each child by objectively assessing pitch accuracy using Adobe Audition CC 2017 visual displays. However, because a child's criterion song performances would very likely also be affected by their level of music aptitude and by their singing competency levels coming into the study, I also administered pretests to determine developmental music aptitude levels and baseline singing competency. Those data were used as covariates in the final analysis to further clarify any effect of the treatment condition.

External Validity

The participants in this study were 3.5- to 5-year-old children (N = 39) enrolled in either half-day or full-day preschool classrooms in a university-affiliated children's center, where music class for each intact classroom occurred once per week for approximately 30 minutes. No data regarding race or ethnic background were collected due to privacy policies at the children's center; however, additional data gathered from parents and guardians showed approximately 23% of the participants speak languages other than English at home, including Spanish, French, German, Chinese, Romanian, Swahili, Luo, and Macedonian. Additionally, approximately 10% of participants experience music activities (e.g., as violin lessons) outside of music class at the children's center. These characteristics of the sample allow the results of this study to be generalizable to many preschool and pre-kindergarten music programs offered at public

or private schools, where preschool students from a wide variety of linguistic and musical backgrounds may receive music instruction for a similar amount of time each week.

Ecological Validity

The ecological validity of this study was also strong, as the music and movement learning activities, criterion songs, and presentation styles used in this study were developmentally appropriate, provided by trained music teachers, and presented in spaces reflective of potential music learning spaces in schools. The taught lessons are accessible to any music educator, as they depend largely on unaccompanied singing and do not require expensive instruments or other equipment. While these results could also be generalizable to private preschool music programs that incorporate parental participation, the musical interactions in these lessons were primarily between students and the music teacher, as they would be in a school setting.

One potential limitation of the study is that the participants likely come from high-socio-economic households. This children's center is in such high demand that waiting lists are long, with enrollment preference given to university affiliates. The cost associated with attendance at the center is fairly high with only a few scholarships available. While it was not within the boundaries of this study to gather household income or employment data of participants' parents or guardians, these families are representative of those who can afford to enroll their children in such a program, rather than those who may choose public or other preschool providers for financial reasons. Though some studies have found children's music-making to be related more to parental involvement than socio-economic status (Brand, 1986), the data from this study may not be generalizable to all socio-economic populations.

Procedures: Schedule of Data Collection and Intervention

The study began in March 2017 and concluded in May 2017. As previously described, in January and February before the study began, all students were participating in weekly music classes with the new music teacher and me. These classes were held both to continue the provision of weekly music instruction as had existed in previous semesters as well as to familiarize the students with their new music teachers. In initial class sessions, the music teacher and I co-taught the music classes. With each consecutive week, the music teacher led more of the music and movement activities, while I mostly participated in a helping role. The initial co-teaching allowed me to be seen both as teacher and researcher; this facilitated continuation of study classes on a few occasions where the music teacher was absent for illness, and it also allowed participants to feel more at ease during data collection sessions. All students in all classes participated in music classes regardless of participation in the study.

Prior to week one of the study, in early March, I administered the tonal section of the pretest measure Audie-T in one-on-one sessions with all participants, followed by the individual baseline singing competency recordings the following week. I used Adobe Audition CC 2017 to record all pretest singing performances. Participation order in these pretests was random within each intact classroom, as it was determined by a mix of classroom teacher recommendation for participant availability and participant response at a given time. For example, a participating child would occasionally be engrossed in a play activity when initially requested and not wish to come with me but would be interested in coming later when that activity had concluded. All pretests were conducted within the center's research room and prior to the daily naptime routine. Data from these

pretests were then stored on the researcher's private computer for analysis at the completion of the treatment.

Music classes during the pre-testing week were conducted as they had been in the pre-study weeks to avoid influencing the pretest of music aptitude. Beginning in week one of the study, the criterion songs were included in the music classes, with treatment and control groups receiving different presentation styles. For all groups, music classes began with a "hello song" and ended with a "goodbye song," with a predetermined variety of songs, chants, and movement activities in between, and with the criterion songs placed randomly within each week's lesson plan. A sample lesson plan outline is shown in Table 2. Table 3 displays the specific schedule for the study.

Table 2

Sample Lesson Plan Outline

Activity	**Description of tasks**
1. Hello Song (Mixolydian duple)	Singing full song; related mixolydian tonal patterns
2. Popcorn (duple chant)	Continuous and beat-keeping movement; duple rhythm patterns
3. Criterion Song 1: Spring! (Major duple)	Continuous movement; singing the resting tone
4. Here is the Beehive (triple chant)	Continuous movement; triple rhythm patterns
5. Criterion Song 2: Puddles (minor triple)	Locomotor movement; singing the resting tone
6. Free Movement Activity	Self-determined movement to recorded music
7. Goodbye Song (Major triple)	Singing full song; related major tonal patterns

Note: Some songs and chants drawn from *Music Play* (Valerio et al., 1998)

Table 3

Study Schedule and Calendar

Task	Dates	Task Details
Pre-study weekly classes	January 10-March 2	Familiarization, building rapport, establishing music class routines. All songs and chants taught with text.
Tonal music aptitude pretest *and* Baseline singing competency pretest	March 1-6	Researcher-conducted, one-on-one sessions with participants to play the musical game "Audie," tonal section only, followed by singing recordings of "*Twinkle, Twinkle, Little Star*." These sessions took place outside of music classes, on non-music class days.
Phase 1 of treatment	March 7-April 20	Intervention-group classes hear and sing criterion songs without text. Control-group classes hear and sing criterion songs with text. All other music class components are the same between groups. One week of no music class during spring break, March 21-23.
Phase 2 of treatment	April 25-May 25	All groups hear and sing criterion songs with text. All other music class components are the same between groups.
Posttest data collection, criterion song recordings	May 24-May 30	Recording task explained to children and criterion songs reviewed. Researcher-conducted, one-on-one pull-out recording sessions with children on non-music class days.

During weeks 1-6 of the study, the intervention-group classes heard and sang the two criterion songs on a neutral syllable, and during weeks 7-11 of the study heard and sang the two criterion songs with the lyrics added to the melody. From weeks 1-11 of the

study, the control-group classes heard and sang the criterion songs with the lyrics. All singing activities were accompanied by predetermined styles of simple movement, including fluid continuous motion and beat-keeping motion. Throughout the weekly music classes, activities resembling the future posttest recording session (holding a toy microphone and/or stuffed animal) were included to help associate those activities with a sense of specialness and enjoyment as preparation for the posttest.

At the beginning of music classes in week 11, I explained to the children that I needed help making some music recordings of two songs, and had the music teacher, myself, and the children review the two criterion songs. Later in the day, a center teaching aide and I brought children one at a time to the research room to sit with the researcher and complete the data collection criterion song recordings. Children were given the opportunity to hold a stuffed animal while they sang into a microphone connected to my computer.

I began each recording by indicating which song would be sung first, playing the tonic D3 on a resonator bell, and singing a preparatory tonal sequence in the tonality of the criterion song. I then sang “Here I sing” on a descending tonic triad to set the tempo for the song and sang the criterion song one time. When I finished, I then played the tonic D3 on the resonator bell again, and sang “Here you sing” on the same descending tonic triad to set the tempo of the criterion song and help the child prepare to sing. This procedure was repeated for the second criterion song. To control for order effects, half of the children were randomly assigned to sing the major criterion song first, and the other half were randomly assigned to sing the minor criterion song first. At the end of each recording, I congratulated the child and thanked them for providing wonderful music to

listen to later. All songs were recorded using Adobe Audition CC 2017 software and stored on my personal computer for later analysis.

Analysis

Analysis of all measures took place after the conclusion of the weekly class sessions. Participants' Audie-T scores were calculated by the researcher and securely stored on the researcher's personal computer. Three independent raters were trained in the use of the SVDM using sample recordings from children who had participated in a portion, but not all, of the study. Each rater was then provided with access to all 90 pretest and posttest recordings on three separate CDs, each of which had been compiled in a randomized order, with ten percent of the recordings repeated to assess intra-rater reliability. To reduce potential error or inconsistency from listening fatigue, raters were asked to listen to and evaluate no more than one CD (30 recordings) per day following the training date. Raters were also provided with printouts of criterion songs in packets coordinated with given CDs, to allow note-taking and the recording of final scores. Inter-rater reliability was calculated at 97%, indicating that the raters evaluated children's use of singing voice similarly. Within two weeks following the training, the raters evaluated all recordings and recorded the relevant SVDM scores and returned all recordings and score sheets to me. I then input and stored these scores in my secure personal computer for later analysis.

While the three independent raters worked to determine SVDM scores, I assessed each recording for pitch accuracy. Because the Adobe Audition CC 2017 software displays pitches as measured in Hertz (Hz), and not in cents as often used in tuning, I translated the "within 50 cents" ranges for each criterion song pitch to the corresponding

Hz measurements. Prior to beginning this process, I had determined the accuracy of the Adobe Audition CC 2017 visual pitch readouts by comparing the Hz measurements of a random sample of ten percent of the participant recordings to pitch readouts on a digital tuner. This comparison showed the Adobe Audition readouts to very precise in displaying the participants' sung pitches. With that validity established, I then assessed the visual Hz measurement readout of every recording pitch-by-pitch to determine the number of correctly-sung pitches for that recording. Pitch accuracy percentage scores for each recording were determined by dividing the number of correctly sung pitches by the total number of pitches in that pretest or criterion song. I then input those percentage scores into my secure personal computer for later analysis.

Summary

The purpose of this study was to examine the effects of with-text and without-text song presentation styles on preschoolers' song-singing competencies of singing voice use and pitch accuracy. In this chapter, the methodology for conducting this study was described. The participants, setting, data collection procedures, measurement tools, and data analysis procedures were explained in detail.

To address the research questions, five intact classes of preschool children at a children's center at a large, Mid-Atlantic university participated in weekly music and movement classes that included two criterion songs composed specifically for data collection. The intact classes were randomly assigned to either an intervention or control condition wherein the criterion songs were presented to students either initially without the associated text, or with the associated text for the duration of the study. Pretests of developmental tonal music aptitude and baseline singing competencies were administered

at the onset of the study, and a posttest of singing competencies was administered at the completion of the 11-week intervention. All pretest and posttest song recordings were analyzed for singing voice use and pitch accuracy, and the resulting scores were statistically analyzed. Results of these analyses are presented in the following chapter.

CHAPTER 4

RESULTS

The primary purpose of this study was to examine the effects of with-text and without-text song presentation styles on song-singing competencies of 3.5- to 5-year-old preschool children. Thirty-nine children across five, mixed-age preschool classes were enrolled in the study. To create two balanced groups from unequal enrollments per class, participants from three classes were combined to form one study group, and participants from the other two classes were combined to form the second study group. The two composite groups (and by extension, the full classrooms of the participants) were then randomly assigned to either the text-only (control) or syllable-text (intervention) song presentation style conditions. In the context of 11 weekly music-and-movement classes, two control group classes were presented with the two criterion songs with text for the full duration of the study; three intervention group classes were presented with the two criterion songs without text for the first six weeks of the study, then with text for the remaining five weeks. Pretests of baseline singing competency and developmental music aptitude were conducted immediate prior to the study. The research questions for the study were:

1. Does presenting new songs with or without text affect the singing voice use of preschool children during song singing?
2. Does presenting new songs with or without text affect the pitch accuracy of preschool children during song singing?

3. Are there any relationships between song presentation style, tonal music aptitude, singing voice use, and pitch accuracy in preschool children?

To fully answer these research questions, I conducted both Analysis of Covariance (ANCOVA) and descriptive statistical analyses for each criterion song, and for criterion song composite scores. Pretest baseline singing competency scores and Audie-T scores of developmental music aptitude were used as covariates for ANCOVA. Pretest and posttest group mean Singing Voice Development Measure (SVDM) scores, and pretest and posttest group mean Pitch Accuracy Percentage (PAP) scores, were analyzed to examine the data for change over the 11-week study period.

In this chapter, I will present: 1) Information related to participants, including explanation of attrition over the course of the study; 2) Results for primary research questions; 3) Results for the secondary research question; and 4) Additional findings.

Participants

Participants in the study were preschool children, aged 3.5 to 5 years old at the beginning of the study, in five intact mixed-age classes at a university children's center in the Mid-Atlantic. At the start of the study, a total of thirty-nine children from the five classes were enrolled, and intact classrooms were randomly assigned to either the control (n = 20) or intervention (n = 19) condition. While children's parents or guardians enrolled them in the study, a known policy of this children's center is that each child may decide whether to participate in data collection on any given day. By the end of the study, 10 of the 39 children were no longer participating for a variety of reasons, resulting in the final

number of participants being 29, with 13 in the control group and 16 in the intervention group. Specific information about causes of attrition is presented in Table 4.

Table 4

Study Enrollment and Causes of Attrition

	Control			Intervention		
	n	girls	boys	*n*	girls	boys
Initial Enrollment	20	11	9	19	9	10
Attrition						
General anxiety (pre-study)	3	1	2	0	0	0
Pretest singing anxiety	1	1	0	1	1	0
Posttest singing anxiety	2	0	2	0	0	0
Illness or other absence	1	0	1	2	1	1
Final Enrollment	13	9	4	16	7	9

It is interesting to note both the higher attrition in the control group and that the number of boys declining participation was more than double the number of girls declining participation. Three children who declined due to general anxiety did not come for pretesting at all; two children comfortably took the Audie-T pretest and then refused to sing during pretesting. Two children who had been comfortable during the pretest singing did not want to sing the criterion songs for posttesting, and three children were not included in data analysis because they missed the pretesting or posttesting weeks because of illness or unexpected travel.

Change in Data Analysis Focus

My initial plan for data analysis included conducting ANCOVA for SVDM and PAP scores, both for individual criterion song scores and for criterion song composite scores, with the children's pretest Audie-T and BSC scores as covariates. However, as I

carried out these analyses it became evident that the collected data did not meet the assumptions of linearity and normal distribution required to continue. Because those assumptions could not be met in any data set, the following pages instead include results of descriptive, non-parametric, and correlational statistical analyses. This outcome is not terribly surprising given the age range of the participants. Gordon (2003) indicated that during the stages of preparatory audiation musical aptitude is "developmental," and is more fluid than fixed; it stands to reason that change and growth may be highly individualized. Data for the current study showed a wide, but skewed, range of pretest scores for both singing competencies and developmental music aptitude, with a few outliers in each condition. Complete raw data for this study are provided in Appendix F.

Descriptive Statistical Analyses

To best determine the potential effect of the intervention on participants' SVDM and PAP scores, I analyzed changes in group mean scores for the text-only control and syllable-text intervention groups from pretest to posttest. Before presenting these results, it may be helpful to re-state that the pretest singing task, "*Twinkle, Twinkle Little Star*," was chosen for its familiarity to the children and usefulness in providing a good representation of their baseline singing competencies. Participants may have heard this familiar song for many months, if not years, leading up to the study. The criterion songs, in contrast, were specifically composed for this study to ensure their "newness" to all participating children. These songs were presented to and sung with the children for 11 weeks; many general music teachers teaching young children may encounter curricula or seasonal sessions of teaching that last for a similar time period. The following analyses give a picture of how the intervention and control conditions may have impacted the

children's singing competencies as they learned new songs in a classroom environment over approximately three months.

I would also like to acknowledge that despite participants' random assignment to the text-only control and syllable-text intervention conditions, intervention group baseline means determined at pretesting were lower than those of the control group for both singing voice use and pitch accuracy percentage scores. It would have been ideal to have the groups closer to equal at the outset of the study; however, numbers of participants enrolled per class, a specific avoidance of pretest score knowledge on my part (to avoid influencing interactions with specific children), and the need to prioritize equal group sizes led to non-equivalent means for the group baseline scores. Fortuitously, this discrepancy may provide valuable information about the usefulness of the syllable-text intervention and text-only control conditions to lower- and higher-competency preschool singers.

Singing Voice Use Group Mean Scores

I analyzed the children's levels of singing voice use and developmental changes over the course of the study using Rutkowski's (1998) SVDM. After averaging the three raters' SVDM scores for each participant to "restore" scores to the SVDM values, I then used those restored scores to calculate group mean scores, standard deviations, and standard error values for each singing task: 1) baseline singing competency (BSC) scores for singing voice use (SVU); 2) SVU for the major criterion song; 3) SVU for the minor criterion song; and 4) SVU for the criterion song scores combined. These analyses are presented below.

Major Criterion Song

Over the course of the study, the group mean SVDM score for the text-only control group increased from 4.1 to 4.4 for the major tonality criterion song, indicating that this group remained in the "initial range singer" category. The group mean SVDM score for the syllable-text intervention group increased from 3.5 to 4.2 for the major tonality criterion song, indicating that this group moved from the "inconsistent initial range singer" category to the "initial range singer" category. Standard deviations and standard error decreased for both groups. Group mean SVDM scores and changes for the major criterion song are shown in Figure 1.

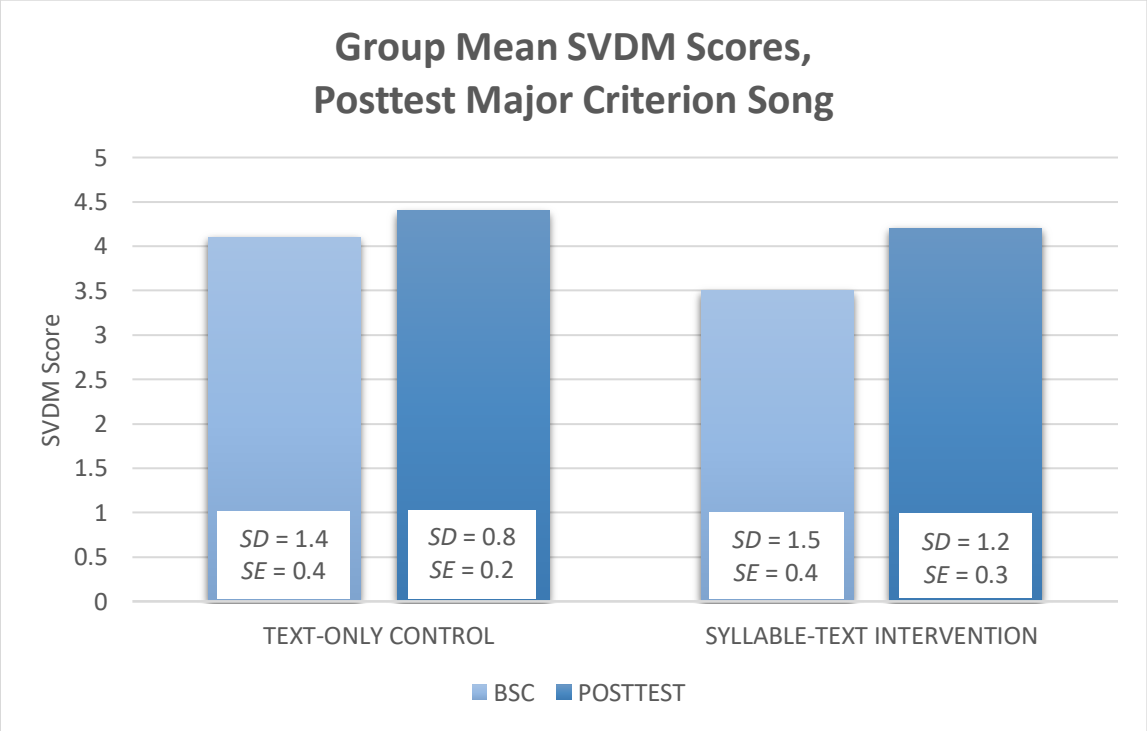

Figure 1. Song presentation style and singing voice use: Major criterion song

Minor Criterion Song

Over the course of the study, the group mean SVDM score for the text-only control group decreased from 4.1 to 3.6 for the minor tonality criterion song, indicating that this group moved from the "initial range singer" category to the "inconsistent initial

range singer" category. The group mean SVDM score for the syllable-text intervention group increased from 3.5 to 3.6 for the minor tonality criterion song, indicating that this group remained in the "inconsistent initial range singer" category. Standard deviations and standard error decreased similarly for both groups. Group mean SVDM scores and changes for the minor criterion song are shown in Figure 2.

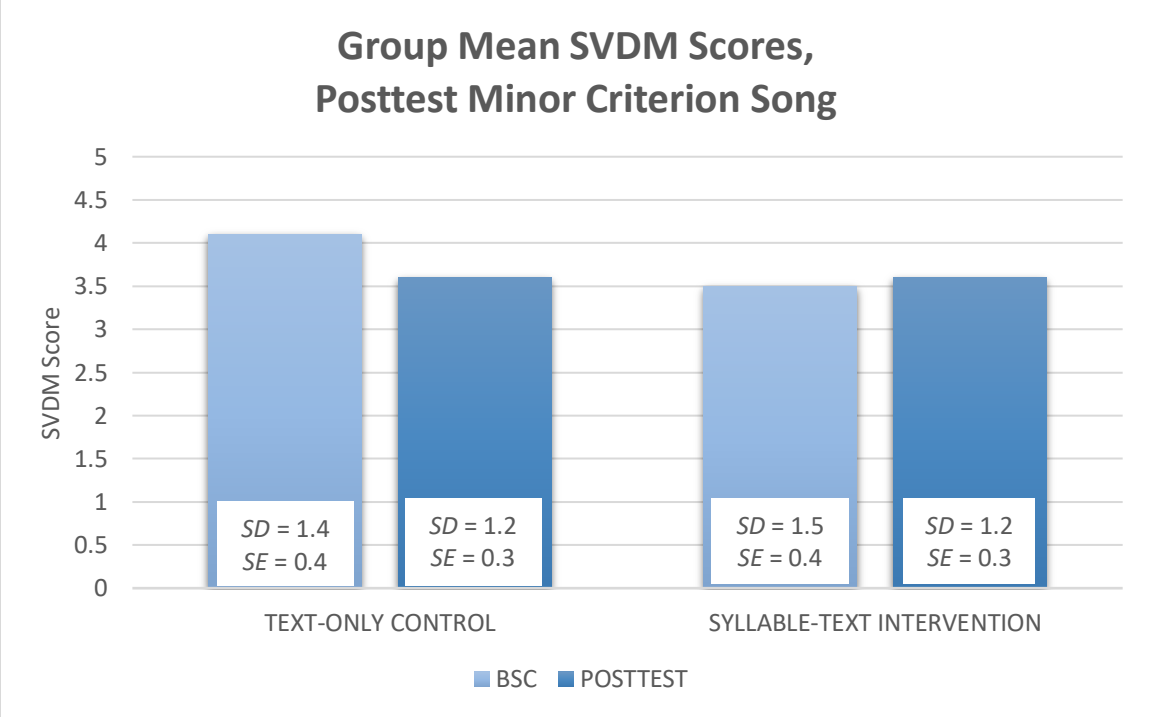

Figure 2. Song presentation style and singing voice use: Minor criterion song

Criterion Songs Composite

To discern overall effects of the syllable-text intervention and text-only control conditions on the participants' singing voice use and development, the group mean scores for the major and minor criterion songs were averaged for each group. I have labeled this measurement the "criterion songs composite." The group mean SVDM score for the text-only control group decreased from 4.1 to 4.0 for the criterion songs composite, indicating that this group remained in the "initial range singer" category. The group mean SVDM

score for the syllable-text intervention group increased from 3.5 to 3.9 for the criterion songs composite, indicating that this group stayed within the "inconsistent initial range singer" category. Standard deviations and standard error decreased similarly for both groups. Group mean SVDM scores and changes for the Major criterion song are shown in Figure 3.

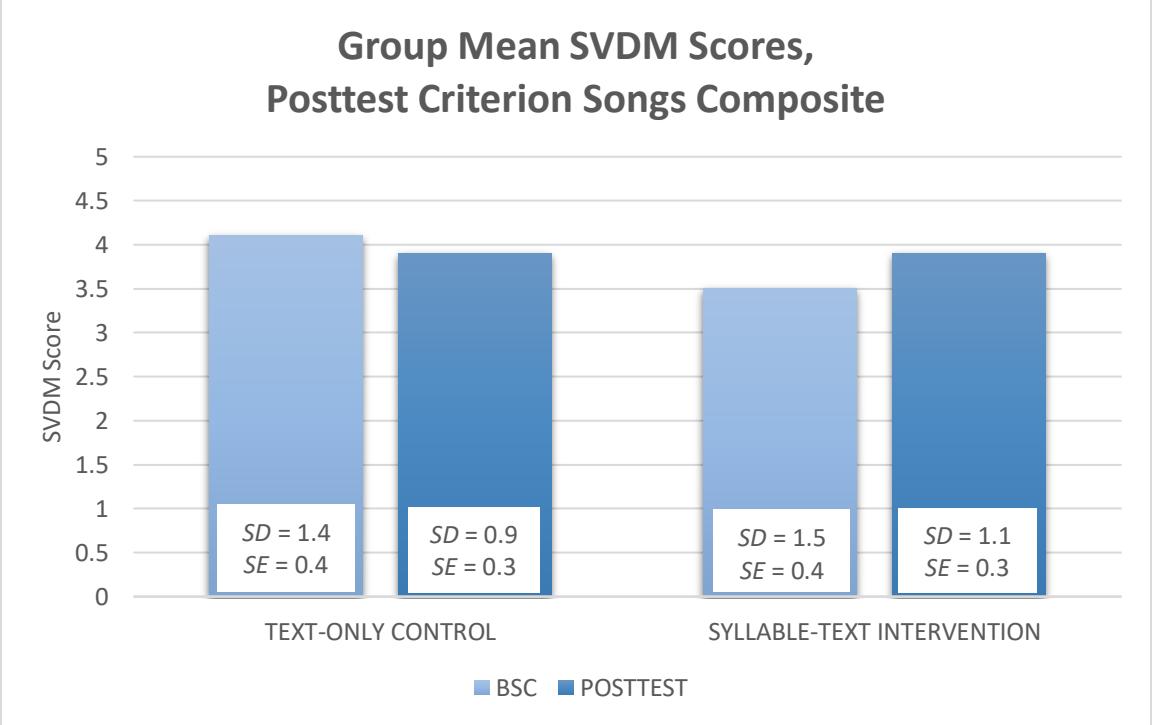

Figure 3. Song presentation style and singing voice use: Criterion song composite

Pitch Accuracy Percentage Group Mean Scores

Because access to one's singing voice register does not guarantee pitch accuracy, I also analyzed the groups' mean PAP scores. These scores were calculated by dividing the number of pitches sung correctly (within 50 cents of the target pitch) by the total number of pitches in the recorded song. Correct pitches were determined by visual inspection of Adobe Audition CC 2017 displays of the children's recordings. The recordings were displayed in Hertz, and I translated the "cents" accuracy range into the

corresponding Hertz range for each target pitch for analysis. The pretest song contained 42 pitches, many of which are repeated; the criterion songs each contained 20 pitches. Results for PAP scores are shown for each criterion song individually and averaged together in the criterion song composite, as with the SVDM data previously shown.

Major Criterion Song

Over the course of the study, the group mean PAP score for the text-only control group decreased from 39 percent accuracy to 19 percent accuracy for the major criterion song. The group mean PAP score for the syllable-text intervention group also decreased, from 21 to 19 percent accuracy, for the major criterion song. Standard deviation and standard error decreased in both groups. Group mean PAP scores and changes are shown in Figure 4.

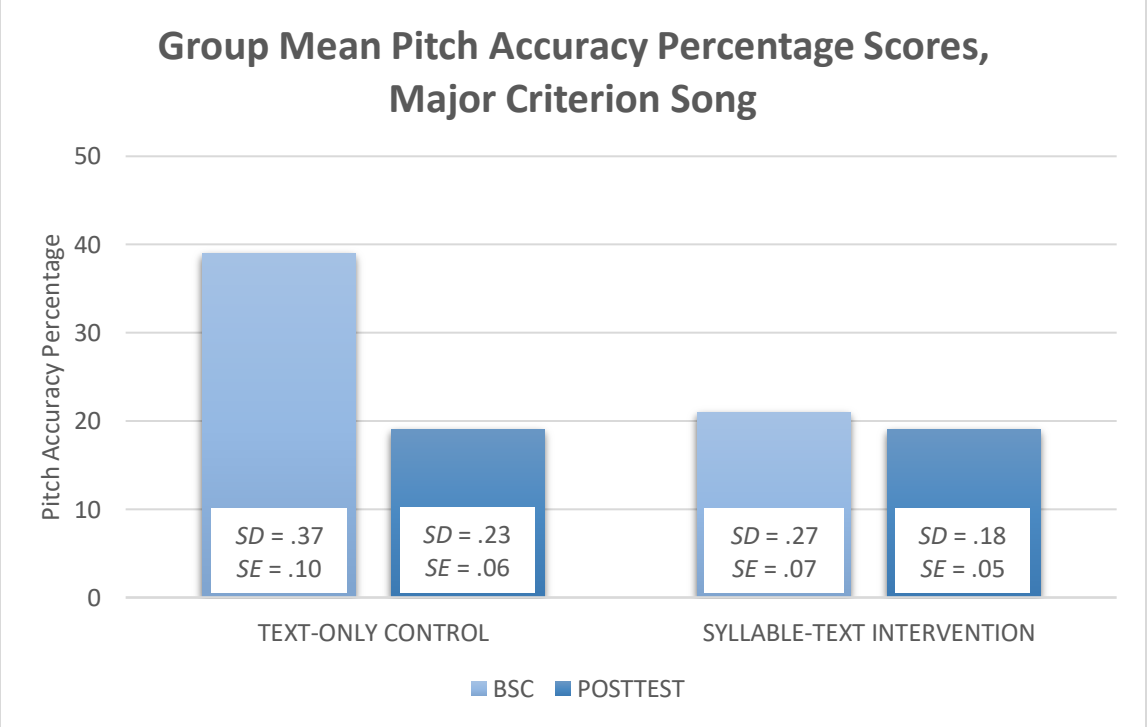

Figure 4. Song presentation style and pitch accuracy: Major criterion song

Minor Criterion Song

Over the course of the study, the group mean PAP score for the text-only control group decreased from 39 percent to 18 percent for the minor criterion song. The group mean PAP score for the syllable-text intervention group also decreased from 21 percent to 14 percent for the minor criterion song. Standard deviations and standard error decreased similarly for both groups. Group mean PAP scores and changes are shown in Figure 5.

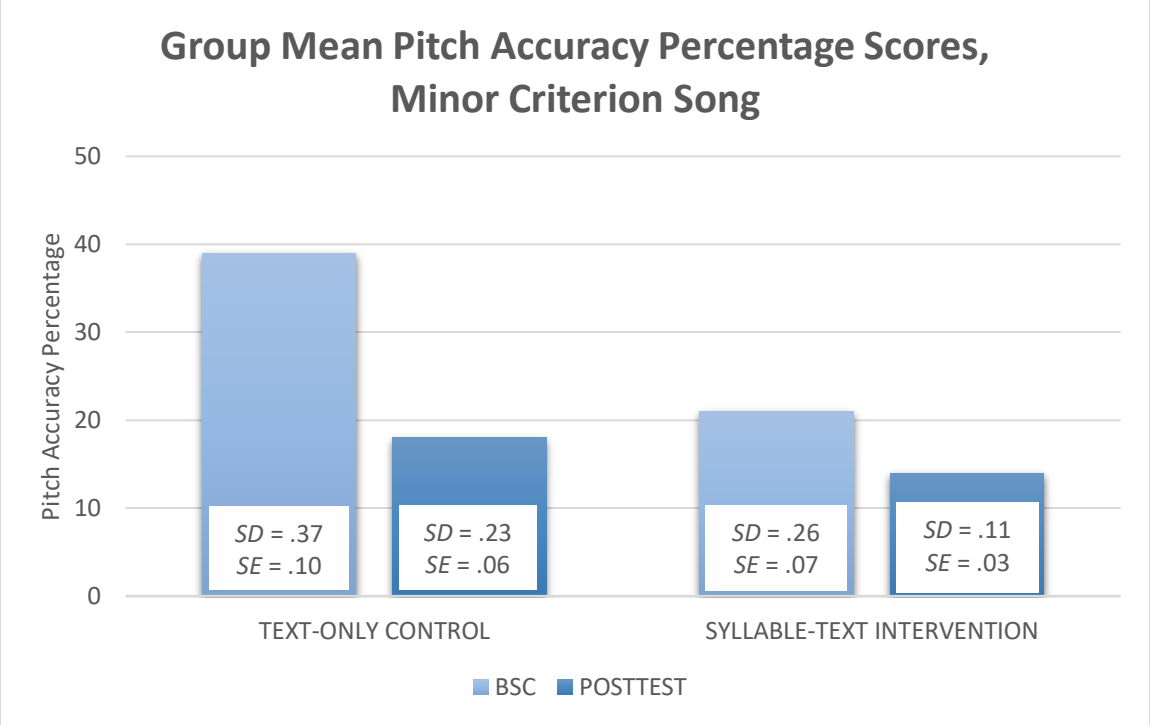

Figure 5. Song presentation style and pitch accuracy: Minor criterion song

Criterion Song Composite

The group mean PAP score for the text-only control group decreased from 39 percent to 20 percent for the criterion song composite. The group mean PAP score for the syllable-text intervention group also decreased from 21 percent to 16 percent for the criterion song composite. Standard deviations and standard error decreased in both groups. Group mean PAP scores and changes are shown in Figure 6.

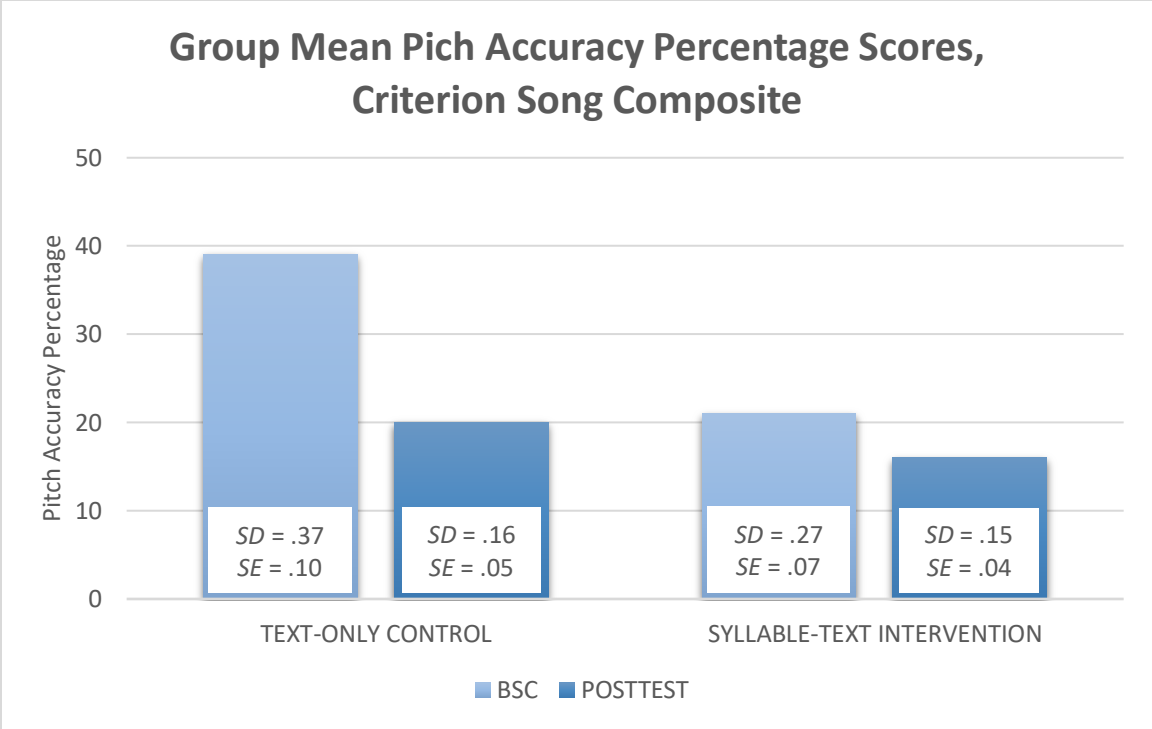

Figure 6. Song presentation style and pitch accuracy: Criterion song composite

Mann-Whitney U Tests for Distribution and Median Scores

As previously stated, the collected data did not meet several of the assumptions required to run the planned ANCOVA tests; the same was true regarding other parametric tests. Therefore, to further investigate the data, I chose to run non-parametric Mann-Whitney U tests to determine if there were differences in distributions and median scores between the control and intervention groups. SVU and PAP scores for the BSC song "*Twinkle, Twinkle, Little Star*" the two posttest criterion songs, and the criterion song composites were analyzed. Distributions for all tests were similar, as assessed by visual inspection. Scores on all measures were not statistically significantly different between the control and intervention groups. Median scores, *U* scores, *z* scores, and *p* values are presented in Table 5.

Table 5

Results of Independent-Samples Mann-Whitney U Tests for Singing Voice Use and Pitch Accuracy Percentage Scores, By Condition

	Text-Only Control (n = 13)	Syllable-Text Intervention (n = 16)			
Measure	*Mdn*	*Mdn*	*U*	*z*	*p*
Singing Voice Use					
Baseline Singing Competency	5.0	3.75	83.0	-.979	.374
Major Criterion Song	4.5	4.5	95.0	-.419	.714
Minor Criterion Song	4.0	4.0	95.5	-.380	.714
Criterion Song Composite	4.5	4.5	107.0	.138	.914
Pitch Accuracy Percentage					
Baseline Singing Competency	.41	.08	80.5	-1.060	.308
Major Criterion Song	.15	.18	111.5	.332	.746
Minor Criterion Song	.05	.10	112.0	.355	.746
Criterion Song Composite	.13	.13	96.5	-.330	.746

Correlational Analyses

Correlations Between BSC and Criterion Song Scores

To help answer the secondary research question, I first ran Spearman's rank-order correlations to discern any predictive relationships between participants' Baseline Singing Competency scores and their SVU and PAP scores for the two criterion songs and the criterion songs composite. Preliminary analyses showed relationships to be monotonic, as assessed by visual inspection of scatterplots. The data showed moderate-to-strong positive correlations between BSC and posttest SVU scores in the intervention group, as well as between BSC and posttest PAP scores in the control group; all of these correlations, except that between BSC and posttest PAP scores for the minor criterion song (control group) were statistically significant. In contrast, the data showed weak

positive correlations between BSC and posttest SVU scores for the control group, and also weak positive correlations between BSC and posttest PAP scores for the intervention group. None of these correlations were statistically significant. Specific correlational data, including r_s and *p v*alues, are presented in Table 6.

Table 6

Spearman's Rank-Order Correlations Between Baseline Singing Competency Scores and Criterion Song Scores, By Condition

	Text-Only Control (n = 13)		Syllable-Text Intervention (n = 16)	
	r_s	p	r_s	p
Singing Voice Use				
Major Criterion Song	.394	.183	.548*	.028*
Minor Criterion Song	.355	.234	.606*	.013*
Criterion Song Composite	.436	.136	.624*	.010*
Pitch Accuracy Percentage				
Major Criterion Song	.564*	.045*	.424	.102
Minor Criterion Song	.514	.073	.191	.479
Criterion Song Composite	.797**	.001**	.366	.163

*$p < .05$
**$p < .01$

Correlations Between Audie-T and Singing Competency Scores

To continue answering the secondary research questions, I again ran Spearman's correlations to identify any predictive relationships between participants' Audie-T scores, their baseline singing competency scores, and their posttest scores for the criterion songs and criterion song composites. Interestingly, the data show a moderately positive and statistically significant correlation between Audie-T and BSC SVU scores for the text-only control group, and a slightly negative and not statistically significant correlation for these same scores for the syllable-text intervention group. While the correlations for BSC

PAP scores and Audie-T scores were not statistically significant for either group, the direction of the relationships remained the same: a moderately positive correlation for the text-only control group, and a slightly negative correlation for the syllable-text intervention group.

Correlations between Audie-T scores and posttest SVU scores for the text-only control group were all moderately positive, and those for the minor criterion song and the criterion song composite were statistically significant; the correlation between Audie-T scores and the major criterion song approached significance. For the syllable-text intervention group, all correlations between Audie-T scores and posttest SVU scores were weakly positive and not statistically significant, and similar to SVU correlations, the posttest PAP scores were weakly positively correlated with Audie-T scores and not statistically significant. Specific correlational data, including r_s and *p v*alues, are presented in Table 7.

Correlations Between Singing Voice Use and Pitch Accuracy

Lastly, to investigate the potential relationship between singing voice use and pitch accuracy, I ran additional Spearman's rank-order correlations for the control group and for the intervention group, by task. Across all task pairings, pitch accuracy was highly correlated with singing voice use; to accurately sing melodies that are in a developmentally appropriate range for young children, a child must be able to lift out of a potentially lower speaking voice and into their singing voice. Specific correlational data is provided in Table 8.

Table 7

Spearman's Rank-Order Correlations Between Audie-T Scores and Singing Competency Scores, By Condition

	Text-Only Control (n = 13)		Syllable-Text Intervention (n = 16)	
Task	r_s	p	r_s	p
Singing Voice Use				
Baseline Singing Competency	.598	.031*	-.097	.720
Major Criterion Song	.540	.057	.254	.343
Minor Criterion Song	.616	.025*	.316	.234
Criterion Song Composite	.633	.020*	.324	.220
Pitch Accuracy Percentage				
Baseline Singing Competency	.422	.151	-.185	.492
Major Criterion Song	.546	.053	.333	.208
Minor Criterion Song	.180	.557	.342	.195
Criterion Song Composite	.506	.077	.333	.207

*$p < .05$

Table 8

Spearman's Rank-Order Correlations Between Singing Voice Use and Pitch Accuracy Percentage Scores, By Task

	Text-Only Control (n = 13)		Syllable-Text Intervention (n = 16)	
Task	r_s	p	r_s	p
Baseline Singing Competency	.852**	.000**	.826**	.000**
Major Criterion Song	.876**	.000**	.825**	.343**
Minor Criterion Song	.656*	.015*	.653**	.006**
Criterion Song Composite	.866**	.000**	.802**	.000**

*$p < .05$
**$p < .01$

Summary of Findings

To address the primary and secondary research questions, I initially conducted ANCOVA and descriptive statistical analyses for criterion song scores and for criterion song composite scores. Because the data did not meet the assumptions of linearity and normal distribution required to continue with ANCOVA or other parametric analyses, I focused instead on descriptive, non-parametric, and correlational statistical analyses to answer the research questions. As seen in the descriptive analyses, group mean SVU posttest scores were greater than mean BSC SVU scores for both the text-only control and syllable-text intervention groups for the major criterion song. For the minor criterion song, group mean SVU posttest scores were greater than group mean BSC SVU scores for the syllable-text intervention group and lesser for the text-only control group. Analysis of composite criterion song scores showed an overall maintenance of group mean SVDM scores for the text-only control group and an overall increase in mean SVDM scores for the syllable-text intervention group, indicating that the syllable-text condition may help children improve their singing voice use.

Similar analyses of the PAP scores showed that group mean posttest PAP scores for both the text-only control and syllable-text intervention groups were less than their group mean BSC PAP scores. The text-only control group's PAP scores decreased very similarly for both criterion songs, as did the syllable-text intervention group's PAP scores. The overall decrease in pitch accuracy was greater for the text-only control group than for the syllable-text intervention group; as a result, group mean scores were more comparable across condition for posttest singing tasks than for BSC tasks. This may

suggest that the text-only and syllable-text conditions have similar impacts on preschoolers' pitch accuracy when used to teach new, unfamiliar songs.

Mann-Whitney U tests were run to provide information about distributions and median scores for the data collected. Across all data sets, distributions were found to be similar between the text-only control and syllable-text intervention groups, and group median scores were found to be not statistically significantly different between the two conditions. Spearman's correlations showed that Baseline Singing Competency scores seemed to predict PAP scores in the text-only control group and SVU scores in the syllable-text intervention group. These results indicate that while children may be likely to maintain or increase their BSC level of singing voice use when presented with new songs on a neutral syllable first, they may maintain their BSC level of pitch accuracy more easily when singing new songs with text.

Spearman's rank-order correlational analyses showed that though Audie-T scores were positively correlated with SVU and PAP scores for the text-only control group, this was not the case for the syllable-text intervention group. The syllable-text intervention group scores did move from weakly negative correlations to weakly positive correlations over the course of the study; however, the differences in correlations, as well as these changes, may suggest that singing competency scores may not always be an indication of preschoolers' developmental tonal music aptitude levels.

Finally, additional correlational analyses showed SVU and PAP scores to be highly and statistically significantly correlated across all tasks, suggesting that the two competencies are interdependent, and that preschoolers' level of singing voice use is likely predictive of their level of pitch accuracy. Further discussion of the SVU and PAP

scores and changes, as well as conclusions and recommendations for practice, are provided in the following chapter.

CHAPTER 5

DISCUSSION

First, In Their Words

It was time to begin "phase two" with the intervention group classes, and so we said to the Green Room students:

"Friends, you have been doing a marvelous job singing our "Spring" song, and it is time to plant something new in your brains! Today, we will learn words that go with our "Spring" song!"

After the music teacher presented the song with text a few times, to my surprise "Mary" (an already-high-competency singer who is bilingual) pinned me with an annoyed stare, fists on her hips, and said:

"I don't like it this way. I liked it the other way!"

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Near the end of the study, the participant children knew that they would soon get to come to the research room again to sing with Largo. For some, this opportunity is particularly exciting:

"Is it my turn to sing in the microphone yet? Can I sing the Springtime song for you today? I ***love*** *the Springtime song! See? Skies are blue, grass is green, little birdies sing…"*

"Sorry," Logan's mom interrupted with a smile. "We'll let you get your things cleaned up! But as you can see, Logan loves this song!"

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The purpose of the present study was to examine the effects of with-text and without-text song presentation styles on singing voice use and pitch accuracy in preschool children. Toward this purpose, I utilized a quasi-experimental, pretest-posttest study design to answer two primary research questions: 1) does presenting new songs with or without text affect the singing voice use of preschool children during song singing, and 2) does presenting new songs with or without text affect the pitch accuracy of preschool children during song singing, as well as one secondary research question: are there relationships between tonal developmental music aptitude, song presentation style, and singing competencies in preschool children. A total of 29 preschool children at a university children's center in the Mid-Atlantic participated in pretests of developmental tonal music aptitude and singing a familiar song as well as posttest singing performances of two new, unfamiliar criterion songs. All singing was recorded with the use of Adobe Audition CC 2017 on the investigator's personal computer. Participating children had been randomly assigned within intact classes to either the text-only control or syllable-text intervention conditions. Children in the text-only control group classes were presented with the two criterion songs with the accompanying texts for all eleven weeks of the study; children in the syllable-text intervention group were presented with the two criterion songs for six weeks on a neutral syllable, then with the accompanying texts for the remaining five weeks of the study.

To help answer the first primary research question, participants' recorded performances were coded for anonymity and compiled in random order for evaluation. Three trained raters used the Singing Voice Development Measure (Rutkowski, 1998) to determine the level of singing voice use for each recording, and interrater reliability was

found to be very high. To help answer the second primary research question, the investigator utilized the visual output of Adobe Audition and a digital tuner to determine the pitch accuracy percentage for each recording. After discovering that collected data did not meet the assumptions of linearity and normal distribution required for the planned ANOVA, data were instead analyzed using descriptive, non-parametric, and correlational statistics.

This chapter includes the following: a) a summary of findings; b) discussion of findings and conclusions; c) interpretations of findings in the context of existing research; d) implications for music education; e) limitations of the study; and f) recommendations for future research.

Summary of Findings

1. There were no significant differences found in median singing voice use (SVU) scores between the text-only control group and the syllable-text intervention group.
2. Mean group SVU scores show that the text-only control group maintained their baseline singing competency (BSC) score for singing voice use, while the syllable-text intervention group increased their singing voice use during the study.
3. Close examination of individual SVU data revealed that more children moved down a full SVDM category or more in the text-only control group, while more children moved up a full SVDM category or more in the syllable-text intervention group.

4. There were no significant differences found in median pitch accuracy percentage (PAP) scores between the text-only control group and the syllable-text intervention group.
5. Mean group PAP scores show that both the text-only control and syllable-text intervention groups declined in pitch accuracy from their BSC scores when singing the criterion songs.
6. Singing voice use scores strongly predicted pitch accuracy percentage scores in all task comparisons; as singing voice use increases, so does pitch accuracy.
7. Preschoolers' singing voice use may be supported by presenting new songs to preschool children first without text.
8. Preschoolers' pitch accuracy may be supported by presenting new songs to children with text.
9. Preschoolers' apparent singing voice use and pitch accuracy in song-singing performances may or may not be reflective of their developmental tonal music aptitude levels.

Discussion and Conclusions

Initial Group Differences

One potential complication in the present study was the initial differences in group mean scores between the text-only control and syllable-text groups, both for singing voice use and pitch accuracy. Because of the prioritization of creating (initially) equal sample sizes for the groups, and then the random assignment of those created groups to the two conditions, it was not possible to have the two groups matched in scores at the outset of the study. However, these initial differences are likely reflective of

what music educators may face in needing to differentiate instruction both between and within the classrooms they teach, and the following discussion and implications presented will acknowledge and reflect on the usefulness of this initial disparity.

Group Mean and Median SVU Scores

Group mean BSC SVU scores were calculated for the pretest to establish baseline levels of singing voice use, and standard errors for BSC SVU scores were near 0.4 for both groups. Rutkowski (1990) found comparable standard errors and interpreted SVDM score changes of 0.5 or less as "no change;" I chose to use this 0.4 value similarly as a baseline standard error, and in the following discussion, changes in SVDM scores of 0.5 or less are also interpreted and communicated as "no change."

For the major criterion song, group mean scores for the text-only control group stayed in the category of "initial range singer," while the group mean scores for the syllable-text intervention group moved from "inconsistent initial range singer" to "initial range singer." The consistency of the text-only control group showed that their SVU scores were not impacted by learning a new, major tonality song with text. The increase of .7 in the mean score of the syllable-text intervention group indicates that these participants' SVU may have been positively impacted by the syllable-text presentation strategy, particularly in greater consistency accessing the D3-A3 singing range as they moved from "inconsistent initial range singer" to "initial range singer."

For the minor criterion song, the text-only control group mean SVU score decreased 0.5. Though interpreted for the present study as "no change," this decrease did demonstrate a move from "initial range singer" to "inconsistent initial range singer" on the SVDM scale. The syllable-text intervention group mean SVU score remained in the

"inconsistent initial range singer" position. These results suggest that in learning a new minor tonality song, the combination of a likely-less-familiar tonality plus text was confusing to some children in the text-only control group, slightly detracting from their singing voice use. Though previous research (Rutkowski, 1990) has found that children sing as easily in minor tonality as in major or pentatonic tonalities, it is likely also the case that children need to be routinely exposed to a variety of tonalities in early music development to have those sounds and syntaxes not be unfamiliar (and potentially more difficult to audiate). Many folk songs from a variety of world cultures, simple songs without words, and instrumental music pieces could be used to provide this tonal variety to young children through listening, movement, and singing experiences. Though I know participants were receiving weekly music classes and sing-along opportunities prior to the start of the study, I am uncertain whether many songs in tonalities other than major were included in those sessions.

An "overall" view of the group differences through the criterion song composite scores showed that the groups stayed largely the same in singing voice use, with slight increases, over the course of the study; this is consistent with results of previous research that showed significant changes in young children's singing voice use generally require longer periods of time than provided in this study. The maintenance of scores, though, seems to indicate that the two conditions were generally equally effective at maintaining children's baseline singing competency in this area, despite the presented songs being much less familiar than the pretest song "*Twinkle, Twinkle, Little Star*." The general format of the singing instruction, including the teaching procedure, vocal model, and inclusion of singing routine opening and closing songs, was the same in each group and

may have also contributed to the successful maintenance of BSC SVU scores. Svec (2015) found that singing instruction was generally an effective means of increasing children's singing achievement, and while it was informal in nature, the music lessons for the study did provide singing instruction to both groups.

It is also interesting to note that the increase in the syllable-text intervention group's mean SVU score brought them much closer to equal with the text-only control group than they had been at the beginning of the study. This change was also evident in my comparison of median SVU scores through Mann-Whitney U tests. While not statistically significant, the differences in median scores between the groups were eliminated over the course of the study, indicating that learning new songs initially without text may have assisted some children in accessing their singing voices more consistently than when their BSC was measured. Learning new songs always with text may have hindered some children in accessing their singing voices as consistently as they did at the BSC measurement.

Finally, because the small sample size certainly left descriptive analyses vulnerable to outliers, I more closely examined the data to discern if larger-than-average changes may have impacted the group scores, and to what extent. Many children in both groups remained in the same SVDM category (or very close) from the beginning to end of the present study, as evidenced by no change in score or by only a 0.5 increase or decrease. But there were also children who moved one or more full points on the rating scale, and it is pertinent to acknowledge those changes not only for mean score influence but also understand how the conditions may have affected specific learners' SVU. In the text-only control group, 7 of the 13 participants exhibited no change; 4 participants

moved down (1-1.5 points); and 2 participants moved up (1 point, 3 points). In the syllable-text intervention group, 9 of 16 children exhibited no change; 2 children moved down (1 point, 1.5 points); and 5 children moved up (1-3 points). Raw data are provided in Appendix F for a complete picture of individual changes. Though it is not clear what may have caused initial group differences in SVU, it is potentially useful to note that those differences may have both showcased some participants' growth and potentially hidden it for others. While more children increased their use of SVU in the syllable-text intervention condition, that may have been influenced by a possible "ceiling effect" present in the SVDM rating scale. Though equal numbers of participants in the two groups had a BSC SVU score of 5 (the highest possible score) there were more participants in the syllable-text intervention group who had "room" to move upward on the scale more than 0.5 points.

Group Mean and Median PAP Scores

My decision to calculate absolute pitch accuracy scores came from an interest in discerning whether absolute accuracy would be affected by the presence or absence of text in the presentation of new songs, even though previous studies have certainly documented that young children often modulate frequently in their singing (Flowers & Dunne-Sousa, 1990), and that pitch accuracy is likely to increase later in singing development than early childhood (Green, 1990,1994). Therefore, it was not surprising to see that pitch accuracy was lower for the new criterion songs across all tasks in both groups. The data did, however, provide an interesting picture of how pitch accuracy percentage scores changed between the groups, and may provide some insight into the effect of experience and song familiarity, as well.

In fact, despite the familiarity of the pretest BSC song "*Twinkle, Twinkle, Little Star*," even the higher of the group mean scores—the text-only control group—was relatively low at 39%. All tested songs had a D tonic regardless of tonality, which was purposefully chosen both for consistency and to keep the songs in the developmentally appropriate singing range for young children, and the raw data show that for the pretest there were many children in the text-only control group who sang accurately within that range. They were balanced out, though, by many other children who had extremely low PAP scores. The group mean PAP scores of the text-only control group then dropped by 20% and 21% respectively as they learned the major and minor criterion songs with text, but a closer look at the data show that this drop was not the result of all participants' accuracy decreasing, but of the high-accuracy singers' scores dropping fairly dramatically. It may be that these participants' higher scores on the pretest were dependent on the familiarity of the song, perhaps even a result of singing it more prior to the study than other participants. Learning the unfamiliar criterion songs may have presented challenges to pitch accuracy that had been overcome with repetition for the pretest song. Standard deviations in scores for the text-only control group also dropped as the new-song learning task brought most children in this group to closer-to-equal scores.

Group mean PAP scores in the syllable-text intervention group were lower than those of the text-only control group from the outset, as their BSC PAP group mean was 21%. It is interesting to note that their starting score was so similar to the text-only control group's posttest scores but did not decrease in the same proportion over the course of the study. This group's mean PAP score decreased from 21% to 19% for the major criterion song, and to 14% for the minor criterion song. The minor criterion song

was clearly more difficult than the major criterion song for both groups, and I again speculate that the lower familiarity of minor tonality syntax for this group of preschoolers may have impacted their scores.

It may also be that the "mi-do-la" preparatory sequence for singing during testing, though the same as the sequence used in each music class for minor songs, was not as helpful to the children in starting the song as the sequence for the major criterion song, given that the preparatory sequence did not end on the "mi" starting pitch of the song. The "sol-mi-do" sequence used for the major criterion song and the pretest song did end on the starting pitch and may have prepared the children to start those songs more accurately. Even so, the group mean PAP scores for the syllable-text intervention group were not as impacted as those of the text-only control group for either song, and that may be for several reasons: 1) lower starting scores, leaving less room for downward movement; 2) less drastic changes for a few higher-accuracy singers; and 3) that while small, more children in this group had increases in their PAP scores that went beyond the standard error, indicating slight improvements in accuracy. The text-only control group, in contrast, only had a few participants increase their PAP beyond the standard error, and only in single tasks. It may be that the syllable-text intervention, while not improving pitch accuracy for the group, may have mitigated some loss of pitch accuracy and even supported greater accuracy for some participants.

The "overall" picture provided by the composite PAP scores showed that the group mean scores decreased from 39% to 20% for the text-only control group, and from 21% to 16% for the syllable-text intervention group. These decreases in scores seem to support theories describing pitch-accuracy as a later-developed skill (Pfordresher et al.,

2015). Given the generally-higher BSC PAP scores for many children, the data may also indicate that pitch accuracy can increase simply with song familiarity, an idea linked to Demorest and Pfordresher's (2015) assertion that singing accuracy can be improved by experience. It does seem that many preschool children will likely be less pitch-accurate for new songs than they are for familiar songs, and that the new-song learning task "canceled out" initial group PAP score disparities that may have been present from different prior experiences with the pretest song. Similar to the SVU median scores, the differences in group median PAP scores were also not statistically significant. Nevertheless, the change of median scores over the course of the study is intriguing: though not statistically significantly different, by the conclusion of the study the median PAP scores for the syllable-text intervention group had equaled or surpassed those of the text-only control group.

Correlations Between SVU Scores and PAP Scores

One unsurprising, but very helpful and important, result of data analysis was the very high and statistically significant correlation of participants' SVU scores and their PAP scores across all singing tasks. This is consistent with Rutkowski's (2015) analysis of the relationship between kindergarten and first-grade children's use of singing voice and singing accuracy. In the present study, a child's level of singing voice use, in all tasks, strongly predicted their level of pitch accuracy. Of course, absolute pitch accuracy in the pretest and criterion songs used for the present study necessitated singing voice use as measured by the SVDM; to be able to sing those pitches, a child needed to have at least partial access to the "initial range" of D3-A3. But this strong correlation supports Rutkowski's (2015) assertion that singing voice development is foundational to the

development of pitch accuracy, and also to the suggestion of Tsang, Friendly, and Trainor (2012) that perhaps many "poor-pitch singers" have accurate perceptual skills but "impaired integration between perceptual and motor skill" (p. 33). In other words, if children (or adults) can hear differences in pitch but not know how to "place" them vocally, they may end up self-labeling as poor singers, in part, because they do not know how to access their singing voice.

Correlations Between BSC Scores and Criterion Song Scores

Perhaps the most intriguing—and initially perplexing—results came from analyzing the Spearman's rank-order correlations between participants' baseline singing competency scores and their criterion song scores. For the text-only control group, BSC SVU scores were only weakly positively, and non-significantly, correlated with their posttest SVU scores, indicating that their baseline SVU was not a strong predictor of their SVU for the new songs. For this to occur, several children needed to "cross ranks" during the study which may indicate that learning the criterion songs, in this case with text, largely promoted a maintenance of or decrease in singing voice use. Given that many children in this group scored at the top of the SVDM for their BSC, it may be that the presence of text in new songs interfered with singing voice use for some participants, perhaps because their attention is drawn more to the text at this age (Welch et al., 1997). In contrast, text-only control group BSC PAP scores were moderately-to-strongly predictive of their criterion song PAP scores, as well as statistically significant for the major criterion song, and highly significant for the criterion song composite. Text-only control group participants with higher pitch accuracy scores at the beginning of the study were much more likely to remain high in their group's rankings when learning a new

song in this condition. Because PAP scores decreased overall but decreased consistently, we may be able to speculate that a child's current level of pitch accuracy achievement will largely determine how accurate they are able to be when singing the pitches of a new song.

For the syllable-text intervention group, the results of correlational analysis were nearly opposite of the text-only control group. Syllable-text intervention group BSC SVU scores were moderate-to-strongly predictive of posttest SVU scores, and the correlations were also highly significant. A few participants changed ranks, but most maintained their rank. Given that five of these participants improved, and quite a lot in several cases, this indicates that participants with initially high scores mostly maintained their high use of singing voice, and that the syllable-text learning condition, with new songs presented initially on a neutral syllable, seems to have mainly promoted maintenance or improvement of singing voice use. Again in contrast, the syllable-text intervention group's BSC PAP scores were only weakly-to-moderately (and not significantly) correlated with their posttest PAP scores, with the weakest correlation between BSC and the minor criterion song. Correlation was the strongest between the BSC PAP scores and the major criterion song PAP scores, suggesting that children who were more pitch accurate at pretest for the major-tonality familiar song were more likely to maintain their rank for the same-tonality criterion song. The weak predictivity of BSC PAP scores for the minor song PAP scores may indicate that the syllable-text presentation condition for this song was helpful to some children but not to others, and that this approach may not be beneficial to all children's pitch accuracy achievement.

The contrasting results of these correlational analyses seem to support the conclusions that presenting new songs to preschoolers without words may facilitate maintenance and increase of singing voice use, but that the presence of text may facilitate maintenance of pitch accuracy in song-singing tasks. It may be that initially removing the text from a new song could allow a preschooler to focus on the melodic range, register, and perhaps pitch contour of the song, where including the text from the beginning of a song-learning process may make it more difficult for a child to choose attentiveness to register and range over the specific words of the song. Pitch accuracy, however, may be aided by the presence of text, particularly if the text might support specific pitch memory and production. These results weave together several conclusions of prior research, as well as other results of the present study, and may help shape and affirm pedagogical strategies for song learning with very young children. These implications and recommendations will be discussed later in this chapter.

Correlations Between Audie Tonal Scores and SVU

Rutkowski (1996, 2015) has shown that children's singing competencies are not necessarily reflective of their music aptitude, and correlational analyses between participants' Audie-T and SVDM scores support this assertion. For text-only control group participants, Audie-T was a moderately strong and significant (or approaching significant) predictor of their SVU scores. For the syllable-text intervention group, the correlation of Audie-T and BSC SVU scores was weakly negative and non-significant, with several children having high Audie-T scores and low SVU scores at the start of the study. While the text-only control group's moderately strong correlation remained the same over the course of the 11 weeks, the syllable-text intervention group's correlation

did change from weakly negative to weakly positive, indicating that some children's singing voice use was more closely aligned with their music perception abilities during that time. While Audie-T scores could certainly be affected by error, the initial mismatch between some children's high aptitude and low singing competency scores demonstrates that some children may be able to perceive tonal differences in music but not necessarily know how to produce and sing those differences accurately in a song-singing context.

Correlations between Audie Tonal Scores and Pitch Accuracy

Audie-T scores moderately predicted text-only control group pitch accuracy percentage scores for BSC pretest, the major criterion song, and the criterion song composite, with a weak correlation for the minor criterion song. The correlations for the major criterion song and criterion song composite approached significance; the minor song correlation did not. For a new major tonality song, children who scored higher on Audie-T were more likely to score higher in pitch accuracy, but rankings were much less predictable for a new song in minor tonality. Because audiation includes not just inner hearing but also comprehension of music that may or may not have ever been present, a child in preparatory audiation and developmental music aptitude may still be developing the capacity to comprehend and reproduce songs in non-major tonalities and would likely benefit from increased exposure to those less-familiar tonal vocabularies. As previously surmised, it may also be that the combination of new melody, unfamiliar tonality, and new text provided a stumbling block between in perception and production for some children that made pitch accuracy for the minor criterion song particularly challenging.

For the syllable-text intervention group, the relationship of Audie-T scores to PAP scores was similar to the relationship between Audie-T and SVU scores: weakly negative

and non-significant for BSC PAP scores but changed to weakly positive by the posttest PAP scores. Interestingly, the greatest change in correlation was with the minor criterion song. Perhaps the syllable-text learning condition allowed for this improvement, not just in increased access to singing voice use, but also then with pitch accuracy. Because pitch accuracy does seem to be highly correlated with singing voice use, the increased correlation between Audie-T and PAP scores for this group may have been prompted by the increased accessibility of their singing voices, again allowing singing competency to more accurately reflect their developmental aptitude levels. It is possible, therefore, that presenting new songs to preschoolers initially without text may support both their developing audiation as well as their developing singing voice.

Implications for Music Education

Studies of singing development have shown that singing is a skill that can be learned (Demorest et al., 2017; Rutkowski, 1996), that singing development likely occurs across time and on a continuum (Pfordresher et al., 2015), and that experiences during even early singing development can shape a child's current and future perceptions of themselves as a singer and music-maker (Welch, 2006; Stephens, 2012). While some of this development (and many perceptions) will be shaped by musical experiences in the home, music teachers who work with elementary and early childhood students have a great opportunity to impact both how a child sings and how they feel about singing. Song singing is a difficult skill for many children, even throughout elementary school (Nichols, 2016; Demorest, Pfordresher, & Nichols, 2017), but is also a skill that is valued and is an important component of general music education objectives and curricula.

Data for the present study seem to support the possibility that cognitive centration may impact preschoolers' song learning and singing, as well as the application of Patel's (2010) Shared Syntactic Integration Resource Hypothesis to singing development. That is, the children may be able to perceive both melody and text, but focus on producing the text correctly when singing. Similar to previous studies that found little relationship between pitch discrimination and pitch matching abilities (Geringer, 1983; Rutkowski, 2015), Audie-T scores were not predictably correlated with singing competency scores, indicating that children's vocal inaccuracies are likely not the result of pitch perception or discrimination difficulties but may instead be a result of difficulties in coordinating those perceptions with vocal production. Patel suggested that while there are differences in brain areas for cognitive representations (perception) of music and language, it seems that the brain areas where musical and linguistic syntax are processed overlap. Fiveash and Pammer (2014), in an extension of Patel's work, proposed that music and language processing both draw on syntactic working memory, and that there may be "interference in tasks involving both linguistic and musical syntax" (p. 191).

Differences in the groups' singing voice use scores especially appear to support this idea of a small breakdown between perception and vocal reproduction of a new song with text for some children, particularly with regard to singing voice use. It may be that preschool children, if predisposed to focus on the words of a song (Welch et al., 1998; Feierabend et al., 1998), initially have a lower awareness of the vocal register used in a new song. Young children may also potentially have "interference" within musical and linguistic processing demands in their syntactic working memory that lessens their use of singing voice when attempting to reproduce a new song. Flowers and Dunne-Sousa

(1990) found that preschool children had larger vocal ranges when echo-singing pitch patterns than when singing songs within the same range of pitches and proposed that differences in the required level of self-monitoring may have made the song singing task more difficult. Welch et al. (1998) also found that young children were more accurate in reproducing short, simple singing tasks than in singing songs, and Nichols (2016) suggested that fundamental pitch-matching abilities, tonal memory, and song complexity may all affect singing accuracy development. It may be that despite largely correct pitch perception, the production requirements of remembering and self-attentively performing both the melody and text of a new song could be too complicated for some children, prompting them to shrink their vocal range closer to their speaking voice as they focus on reproducing the text.

And lastly, the data for the present study also show that children can achieve high levels of singing competency, and that singing voice use can increase over a period of even a few months. The music lessons designed for the study, within the frame of structured informal guidance, did include many strategies suggested by previous research to support singing development. It is quite possible that some participants' singing development was helped by these strategies, perhaps particularly by the careful attention to appropriate singing ranges, the use of an unaccompanied female vocal model within those ranges, and chances to sing both songs and simple tonal sequences in group and individually. Targeted singing instruction can be an effective way of improving children's singing for children as young as five years old, and it could be that preschool children's singing competencies can be supported by developmentally appropriate singing instruction, as well.

Overall, results of the present study affirm that early childhood, specifically the preschool years, can be a valuable time in singing development—and in encouraging singing development through strategies that can foster audiation and music aptitude, increase access to singing voice, and begin to grow pitch accuracy. Specific pedagogical recommendations are provided below.

Fostering Audiation and Tonal Developmental Music Aptitude

While developmental tonal music aptitude may not always be accurately revealed by preschooler's singing competencies (Rutkowski, 2015), music educators may provide musical environments and experiences that support preschoolers' progress through preparatory audiation and lay a foundation for successful singing. First and foremost, music teachers should refrain from making judgments about young children's musical aptitude based on singing competencies and should encourage parents and caregivers to do the same, with the understanding that singing is a developmental skill. Providing music instruction for preschoolers, including singing instruction, in ways that are informal and playful can provide opportunities for children to hear and experience music in a wide variety of tonalities and meters, to listen, and to respond to music through movement. "Structured informal guidance" (Gordon, 2003) allows music teachers to carefully plan and still respond to young children's contributions, creating engaging spaces for singing interactions in ways that mimic language development.

While no data were collected in this study regarding preschooler's perceptions of learning melodies with or without words, anecdotal evidence and years of teaching experience have shown me that despite a possible predisposition towards words (Welch, 1998), many (if not most) young children will readily engage in singing songs and tonal

patterns without text, especially when those melodies or patterns are accompanied by movement. Some, including students with exceptionalities like "Mary," have appeared to more happily participate when there are no specific words to remember and recreate. Other children, like "Logan," did thrive on the texts of the songs or even had trouble remembering even how to start a song without certain cue words. Creating preschool music lessons that contain a variety of singing experiences, including songs both with and without text and accompanying tonal patterns, may provide more children with opportunities to progress through preparatory audiation and grow in singing voice development.

Increasing Preschoolers' Singing Voice Access and Use

Providing structured informal guidance, including songs presented with and without text, may also help music teachers in their efforts to increase preschoolers' access to their singing voices. The possibility that hearing new songs presented first without text may increase children's singing voice use leads me to recommend that early childhood and elementary general music teachers find ways to incorporate more songs without words into weekly lessons. This may entail planning lessons with more songs and chants, but perhaps of shorter duration, and leaving room to engage children in small, conversational singing interactions in small groups or individually. For educators uncertain how to incorporate songs without words into weekly plans, an easy entrance step may be utilizing songs from the next unit, marking period, or semester for neutral-syllable melodies during current instruction. Children would then have the opportunity to not only internalize and audiate some melodies without text, but also to use those

listening experiences as the bases for learning songs with text in the weeks or months to follow.

When presenting songs to preschoolers, care should be taken to ensure appropriate vocal modeling within children's initial singing range; the overlap between a child's speaking and singing voices during development may be exacerbated by mimicking vocal models who regularly sing too low (Trollinger, 2003). Additionally, giving preschool students a chance to hear their own voices may positively impact their singing voice use. Previous studies have found that small-group and individual instruction can significantly improve young children's singing voice development, and that giving children the ability to hear themselves while singing can be as effective as teacher feedback (Rutkowski, 1996). While these studies were conducted with Kindergarten and first-grade students, similar strategies can be employed naturally within informal music guidance. Other strategies may also be combined with singing songs initially without words. Svec (2015), in a meta-analysis of singing research with children from 5-11 years old, found that kindergarten singing activities generally include exploration of vocal timbres and foundational vocal development, and that even kindergarten students may benefit from vocal development instruction, even if effects seem to be small.

Growing Preschoolers' Pitch Accuracy

Another finding of the present study is that while presenting new songs to preschoolers without words may help increase their singing voice use, the presence of text may support specific pitch accuracy in song-singing for some children. While these two findings might initially seem to be contradictory, they do not need to be in practice.

To reach a wide variety of learners at a variety of developmental levels, it would likely be best to incorporate into lessons some (preferably very simple) songs with words, some songs without words at all, and some songs where the melody and words are taught separately, but eventually put together. The syllable-text intervention used in this study fits with Welch et al.'s (1998) recommendation to teach song elements separately, and with Jacobi-Karna's (1996) conclusion that teaching songs first with a neutral syllable and adding text later could increase some children's singing accuracy. The long-range planning strategy described above may help teachers efficiently incorporate a variety of song material over the course of a school year.

Pitch accuracy in song-singing may be affected both the length of a song and by familiarity, which can reduce the cognitive load and demands on working memory (Tsang, Friendly, & Trainor, 2015). Results of the present study seemed to affirm this, with pitch accuracy percentage scores higher for many participants at pretest than when singing a newer song. Short songs that can be sung repetitively, within the developmentally appropriate vocal range, may afford preschoolers greater chances at helpful familiarity, and teachers may find it useful to return to familiar songs at various points throughout a school year as a basis for pitch accuracy assessment.

Lastly, it is important to note that assessment of both singing voice use and pitch accuracy are possible, even with children as young as preschool-age. Although most music educators would not have the time or resources to be able to assess students individually, with practice and experience use of measures like the SVDM and accessible recording technologies could be used at least a few times annually to gauge students' progress. And within the context of structured informal guidance, teachers may easily

disguise formative singing assessments in the guise of tonal pattern "conversations," encouraging children to be song leaders, and other playful vocal development activities.

Limitations of the Present Study

While the present study had high ecological validity, the most obvious and impactful limitation to data analysis and generalization of results was the very small sample size. In reviewing other studies with very young children, I could see that it was not uncommon to have a large percentage of participants not complete all measurement tasks; that certainly proved true in the present study, with 10 of the original 39 participants dropping out of the study due to singing anxiety, illness, or other absence. It was very helpful to work with a children's center community that was open to research; many local school systems are hesitant to allow researchers to work with students, and therefore it is challenging to access a larger sample from a public preschool population. However, because the participant group for this study was so small and drawn from a convenience sample, the results of the study may not be generalizable to all preschool student populations. Data analysis was also somewhat hindered by the sample size, as the initially-planned ANOVA was not possible with these small groups. Distributions of collected data may have normalized with a larger and more diverse sample.

The length of this study was a fair representation of the time a general music educator may spend with preschoolers in weekly music classes over the course of a few months (often designated as a "quarter," or "marking period,") and fit into the time frame that the children's center needed a replacement music teacher for the semester. The data collection procedures, and frequency, were designed to fit the time allotted without risking participant attrition due to over-testing. Still, the study findings may be limited by

a lack of testing at the mid-point of the study; additional insight into the intervention strategy of presenting new songs with text versus without text may have been gleaned had such mid-point measurement taken place. Extending the study by an additional month may have also provided information about preschoolers' singing voice development and pitch accuracy development over the course of a half school year.

Recommendations for Future Research

Further studies investigating the role of text in preschoolers' song-singing competencies should be conducted with larger and more diverse samples, preferably including preschool programs available within more diverse school systems. It may be pertinent to study the effect of the presence or absence of text on preschoolers' singing voice use alone, without analysis of pitch accuracy. Additionally, studies in cooperation with classroom teachers could yield more information regarding the influence of participants' level of language proficiency and may help control for the potential impact of language development on preschoolers' song-learning, and song-performing, processes. Replication of this study with a population of preschoolers with language delays, including students with learning exceptionalities or students who are learning English as a second language, could illuminate further the impact of song text on preschoolers' singing competencies. Longitudinal studies investigating the effect of listening to and singing songs with and without text on young children's developmental tonal music aptitude may also provide valuable information towards a fuller understanding of how to help students realize a greater level of musical comprehension and enjoyment.

Results of this study pointed to the potential helpfulness of song familiarity to pitch accuracy. It would be interesting to know if a familiarity-based accuracy would be reliant on practicing in a consistent range and key, or if pitch accuracy would be transferable, presuming the pitches were in a song were accessible to the singer. Given the variety of persons who may sing to young children (parents, teachers, siblings, and others), it may be that characteristics of these vocal models impact the extent to which repetition of familiar songs is helpful to children's singing development.

Qualitative and mixed-methods studies including young children's perceptions of and attitudes towards singing might yield great insight as to what motivates and encourages children to engage in singing—or avoid it. While many non-verbal behaviors of participants who chose not to sing for me seemed to indicate anxiety, it would be useful to hear directly from them to be sure. Collaboration with family members and teachers who have many small, informal conversations may prove fruitful, as may the use of wearable recording devices, which may capture musical moments only happening when no one seems to be listening.

My great enthusiasm for early childhood music education has prompted research with children in the preschool years thus far. The inspiration for the present study was the frustrating experience of hearing too many kindergarten children in my classes self-label as "bad singers," and witnessing them already hesitating to participate in singing activities. I passionately advocate for continuing music development research with young children to provide early childhood music teachers with accessible and research-backed teaching strategies, including continuing investigations into best practices for singing development. But as an elementary general music educator I also recommend that future

study of the effects of with- and without-text song presentations on song singing, as well as the effects of other singing skill instruction, include more populations of older children. My personal teaching experience confirms what several researchers have found: that while singing accuracy often improves in the early years of elementary school and may continue on that trajectory for some, it can also decline for many students in the upper elementary grades (Demorest & Pfordresher, 2015; Welch et al., 1998). It would be immensely helpful to continue to grow our knowledge of what strategies and approaches may impact children's abilities to hear, comprehend, and produce song with enough comfort and accuracy to joyfully participate in singing through their lifetimes.

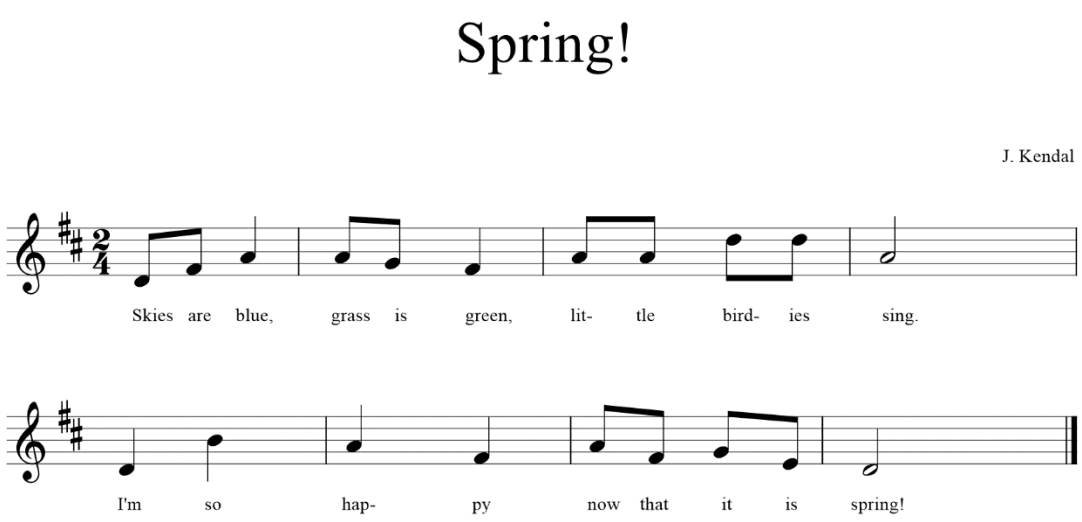
APPENDIX A

Rutkowski's (1998) Singing Voice Development Measure

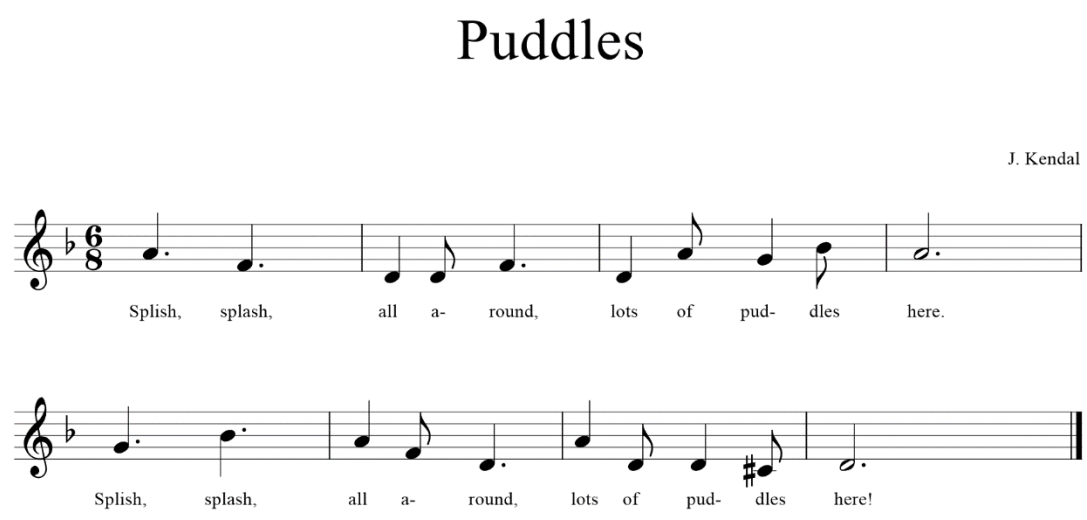
1	"Pre-singer" does not sing but chants the song text
1.5	"Inconsistent Speaking Range Singer" sometimes chants, sometimes sustains tones and exhibits some sensitivity to pitch but remains in the speaking voice range (usually A2-C3)
2	"Speaking Range Singer" sustains tones and exhibits some sensitivity to pitch but remains in the speaking voice range (usually A2-C3)
2.5	"Inconsistent Limited Range Singer" waivers between speaking and singing voices and uses a limited range when in singing voice (usually up to F3)
3	"Limited Range Singer" exhibits consistent use of limited singing range (usually D3-F4) exhibits consistent use of limited singing range (usually D3-F3)
3.5	"Inconsistent Initial Range Singer" sometimes only exhibits use of limited singing range, but other times exhibits use of initial singing range (usually D3-A3)
4	"Initial Range Singer" exhibits consistent use of initial singing range (usually D3-A3)
4.5	"Inconsistent Singer" sometimes only exhibits use of initial singing range, but other times exhibits use of extended singing range (sings beyond the register lift, B3-flat and above)
5	"Singer" exhibits use of extended singing range (sings beyond the register lift, B3-flat and above)

APPENDIX B

Major Criterion Song



Minor Criterion Song



APPENDIX C

Weekly Music Class Lesson Plans: Week 1

Control Group all songs with text
Intervention Group criterion songs on neutral syllable until Week 7

1. Physical warmups with "stretches and wiggles" music

2. Vocal warmups—gentle glides and swoops we'll call "roller coasters," from chest voice into head voice

3. Hello Song
   a. Sing through the whole song with accompanying gestures
   b. "Largo" sings hellos to them for them to echo—major tonal patterns sung on "Hello, Friends"
   c. Whole song with gestures again

4. Popcorn! Chant
   a. Model continuous and beat-keeping movement as we choose different parts to "feel the rhythm of the popcorn" while sitting
   b. Echo some "poppity-pop"-style rhythm patterns, then encourage their own contributions for us to copy
   c. Stand for full-body movement and chanting again several times

5. A new song—Spring! With shaker eggs
   a. We have a new song to sing hear and sing today! It is a song about spring, and it makes me think about beautiful things growing in the springtime. What kind of things do you know that grow when spring comes?
   b. Those are such good ideas! While we sing this new song to you, would you pretend with us that we are baby plants growing in a garden, and while we sing we are growing and stretching slowly toward the sky? Let's take our shaker eggs and pretend we are planting them!
   c. Pantomime and sing tonal patterns along with actions like digging, planting, watering.
   d. Sing song on neutral syllable (or with text) two times, starting with descending tonic triad on "here we grow," each time having kids pretend to grow into a different plant. They are only listening and moving, not singing along.
   e. Echo-sing tonal patterns as our shakers "fly" around in our space
   f. Have them listen and "grow" along two more times as we sing the song

6. Here is the Beehive with shaker eggs

   a. Use shaker eggs to transition into “buzzy bee” rhythms on “buzz,” since bees also come out in spring to fly among the flowers
   b. Perform whole chant with accompanying movements
   c. Encourage kids’ individual patterns
   d. Chant one more time, and collect shakers to put away

7. Another new song—this one is called “Puddles!”
   a. Sit down with sitting spots in front of us; have children pretend their fingers are legs and feet tiptoeing through spots “puddles” as they listen to the new song
   b. Stand and use actual tiptoe feet on the spots in the same way while we toss scarves to them
   c. Echo-sing tonal patterns while tossing scarves into the air
   d. Have them listen to the song two more times while pretending to splash in puddles with their scarves

8. Scrubba Dubba (In the Tub) with scarves
   a. Use scarves to transition to this chant—“oh boy, did we ever get dirty splashing in all of those puddles! We better get cleaned up, so it must be time for a bath! Would you scrub your arms with me?
   b. Go right into chant, perform once while “scrubbing” arms with scarves
   c. Ask for other ideas (legs, necks, bellies) where we should scrub in the tub, ending with “our whole selves”

9. Goodbye song as we collect scarves and help them line up to go back to class

Weekly Music Class Lesson Plans: Week 2

1. Physical warmups with “stretches and wiggles” music
2. Vocal warmups—roller coasters
3. Hello Song
    a. Sing through the whole song with accompanying gestures
    b. Largo” sings hellos to them for them to echo—major tonal patterns sung on “Hello, Friends”
    c. Whole song with gestures again
4. Snowflake song
    a. Can you believe it just snowed yesterday? I know we were just singing about spring, but it sure feels like winter still to me! I think that means I need to turn you into a….snowflake! Get ready—when I toss a scarf to you, you become a snowflake that floats around in its spot!
    b. Toss scarves to children, modeling continuous movement as you sing the song—probably twice through to get a scarf to each child
    c. Toss scarves and turn/twirl as you echo-sing tonal patterns
    d. Sing song again a few times, letting movement be locomotor around the room
5. Go and Stop chant
    a. Quick breeze-through of this chant with different motion words: go, float, fly, tiptoe, etc.
    b. Transition to Puddles song
6. Puddles with scarves
    a. Very similar to last week, but beginning with locomotor movement and scarves
    b. Model movement that is both beat-keeping and continuous while “splashing” in puddles and having the children just listen to the song twice
    c. Toss scarves while echoing tonal patterns
    d. Sit with scarves, bring splashing movements down to personal space as they listen two more times
7. Rolling chant (“yum yum” chant) with scarves
    a. I’m really hungry after all that playing! I think maybe I will mix up some batter for pancakes. Does anyone else like pancakes? Will you stir with me?
    b. Perform the chant together with stirring motions, holding the scarves bunched as if they were spoon handles
    c. Echo rhythm patterns, matching “spoon” movement to the shape of the patterns
    d. Perform the chant again while scarves are being traded for shaker eggs

8. Spring! With shakers
    a. Very similar to last week
    b. Pantomime and sing tonal patterns along with actions like digging, planting, watering.
    c. Sing song on neutral syllable (or with text) two times, starting with descending tonic triad on “here we grow,” each time having kids pretend to grow into a different plant. They are only listening and moving, not singing along.
    d. Echo-sing tonal patterns as our shakers “fly” around in our space
    e. Have them listen and “grow” along two more times as we sing the song

9. Goodbye song to clean up and line up

Weekly Music Class Lesson Plans: Week 3

1. Physical warmups with wiggle music
2. Vocal warmups—roller coasters
3. Hello Song with individual hellos TO Largo
    a. Have them stand up to sing, sticky feet on their dots
    b. Sing one time through, then do group echoes, then ask for volunteers to sing hellos to Largo—their choice of what to sing
    c. Sing whole song one more time through

4. Spring! With song patterns
    a. Ask them to think about what types of things happen when the weather finally switches from winter to spring (plants grow, sunny days and rainy days, baby animals), remind them how we've been growing gardens with our springtime song
    b. This time, we're going to pretend to be baby animals or birds while we listen to the song! (Give choices how to move around the carpet: baby bird or baby turtle? Baby bunny or baby giraffe? Give typical reminders about moving in safe space, but also how these baby animals are great listeners
    c. Move as two different animals while you sing the song
    d. Echo-sing patterns specifically from the song: Do Re Mi, So Do' So, So Fa Re, So Do, pretending to sing/move as whatever animal they were last—patterns on neutral syllable "bum"
    e. Pick two more animals to move like while singing two more times
    f. Transition to turning back into kids so we can play sticks and drums!

5. Rain poem (unknown author) with sticks and drums—no beat to steady beat
    a. When the rain is splashing down
    b. On the fields and on the town
    c. Singing winds begin to blow
    d. And the flowers start to grow!

    e. You chant the poem with some fluid hand motions that match while I put sticks behind their backs
    f. Transition to patting the steady beat on their knees, then to tapping the beat with sticks
    g. Look for "great kids" to pat the beat with fingers on the drums (hopefully everyone in turns)—when kids are at the drums, also have everyone copy rhythms on their sticks and drums that you clap (simple duple)
    h. Make sure everyone has a turn if possible, several more times

6. Puddles with song patterns and scarves
    a. Trade sticks for scarves as you tell them you're going to "splash" them with a scarf, and to make their scarf puddles on the ground like we've done before

b. Have them “pick up their puddle” and splash it around them (model splashing on the beat—splash, splash, splash, etc) while you sing through the song twice
c. Have them stand up and toss and catch their scarves while echoing these patterns
    - La Do La
    - Mi Do La
    - La Mi
    - La Si La
d. Then have them move around the carpet first tiptoeing and then stomping on the beat, pretending to splash through puddles while you sing the song two more times

7. Quick freeze dance with scarves
8. Goodbye song to collect scarves

Weekly Music Class Lesson Plans: Week 4

1. Physical warmups with wiggle music
2. Vocal warmups—roller coasters
3. Hello Song with individual hellos TO Largo
    a. Have them stand up to sing, sticky feet on their dots
    b. Sing one time through, then do group echoes, then ask for volunteers to sing hellos to Largo—their choice of what to sing
    c. Sing whole song one more time through

4. Puddles with song patterns and scarves
    a. Scarves (you hand out) as you tell them you're going to "splash" them with a scarf, and to make their scarf puddles on the ground like we've done before
    b. Have them "pick up their puddle" and splash it around them (model splashing on the beat—splash, splash, splash, etc) while you sing through the song twice
    c. Have them stand up and toss and catch their scarves while echoing these patterns:
        i. La Do La,
        ii. Mi Do La,
        iii. La Mi
        iv. La Si La
    d. Then have them move around the carpet first tiptoeing and then stomping on the beat, pretending to splash through puddles while you sing the song two more times

5. Rain poem (unknown author) with sticks and drums—no beat to steady beat—instrument stations with drums, sticks, eggs, and bells
    a. When the rain is splashing down
    b. On the fields and on the town
    c. Singing winds begin to blow
    d. And the flowers start to grow!

    e. You chant the poem with some hand motions that match while Jes puts sticks behind their backs
    f. Transition to patting the steady beat on their knees, then to tapping the beat with sticks
    g. "Hand over" teaching to Jes
    h. Demonstrating how we can make pitter-patter and "windy" sounds by tapping, shaking, rubbing instruments, and add a special tap on the bells (provided in a major chord) for the end
    i. Steady beat for first two lines, continuous for third line and fourth line

6. Spring! With song patterns

    a. Remind them about turning into baby turtles and birds last week
    b. This time, we're going to pretend to be **different** baby animals or birds while we listen to the song! (Give choices how to move around the carpet: baby bird or baby turtle? Baby bunny or baby giraffe? Give typical reminders about moving in safe space, but also how these baby animals are great listeners)
    c. Move as two different animals while you sing the song
    d. Echo-sing patterns specifically from the song: Do Re Mi, So Do' So, So Fa Re, So Do, pretending to sing/move as whatever animal they were last—patterns on neutral syllable "bum"
    e. Pick two more animals to move like while singing two more times
    f. Transition to turning back into kids so we can play sticks and drums!

7. Quick freeze dance if time
8. Goodbye Song

Weekly Music Class Lesson Plans: Week 5

1. Warmups—stretches with music and vocal roller coasters
2. Hello Song—standing up, even walking around the room "greeting" each other while waving, etc. Just a few group echoes for hellos.
3. Popcorn chant and rhythms—stay standing, and then work back down to sitting
    a. A few wiggles, and then a few movements where we are actually keeping the beat—can ask a few kiddos for the wiggly options (if they say feet, have them sort of run in place, etc.)
    b. Then YOU model the beat keeping movements that can get them back down to a sitting space (marching – patting knees – having hands "pop" open on the beat)

4. Spring! (listening/singing with beat-keeping)
    a. Transition from Popcorn chant by saying something like "just like those last batches of popcorn were popping on a heartbeat steady beat, our songs have heartbeat steady beats, too! Can we try patting our knees gently while I sing the Springtime song to you?" (sing and pat at a slightly faster tempo than previous sessions)
    b. "Great! Can we try showing the heartbeat steady beat with our hands like we did with the Popcorn rhythms?" (sing and have kids do this motion—should be very little noise unless they are singing along, which is fine if they choose to!)

    c. Wonderful! Hey! I think you are SO ready to really sing along with this song. Would you be the same (show "same" hands) AFTER me? I'll sing first—you listen!—and then you sing the SAME thing after me. Let's try it! (Echo sing two-measure segments of the song either with or without the words: Skies are blue, grass is green—little birdies sing—I'm so happy—now that it is spring). Model good breathing and keep patting the beat gently on your knees.

    d. I love hearing you sing! This time, let's try singing the WHOLE thing together while I plant a shaker egg behind your back. Let's see if I can plant for everyone by the time we sing it two times!! (Sing the whole song twice, cueing them in with some words in rhythm and on tonic triad, like "here we sing right now").

5. Here is the Beehive with shaker eggs and "buzzy bee" rhythms
    a. "So cool! Guess what? I feel like with all these spring plants and flowers growing and blooming, there might be some buzzy bees around! Quick, grab your shaker egg and put it in your hands! Let's stand up on our dots, hold on tight to your egg!"
    b. "Who can remember the story to say it with me??" (say it once)
    c. "Who could try to say it in buzzy bee language with me??" (say once with "neutral" buzz syllable)
    d. Model some "buzz buzz" patterns and have them echo, then ask for individual contributions—come around to me if they need redirecting like you've done before.
    e. Perform whole chant with words one more time

6. Puddles (listening/singing with beat-keeping)
    a. Transition to this song by telling them you have a tricky job for them, but you know they can do it—model how you want them to sit down in their spot, but put their dot in front of them. Have them copy you, we may need teacher help on this one.
    b. "Guess what? Let's pretend this time like our DOTS are the puddles, and make our shaker eggs bounce around in the puddles! Make sure they bounce around in the puddle gently (model this for them), and see if you can make them bounce on the heartbeat steady beat like mine! Bounce, bounce, bounce, bounce…"
    c. During this beat-keeping, sing the Puddles song twice
    d. "Friends, you did SUCH a great job singing the Spring song with me earlier that I bet you're ready to help me sing the Puddles song, too! Let's make our shaker eggs rest in our dot puddles for a little bit—see mine? Can you do that too? Great! Now let's get our heartbeat steady beat again by patting gently on our knees (splish, splash, splish, splash)…and then you sing the SAME thing I do, after my turn!"
    e. Echo-sing two-measure phrases with or without words (splish splash all around—lots of puddles here—splish splash all around—lots of puddles here)
    f. Invite them to sing along while making the shakers bounce on the dots again—singing song twice.

7. Freeze dance with shakers if time
8. Goodbye song

Weekly Music Class Lesson Plans: Week 6

1. Warmups: with music and vocal roller coasters (we'll keep these quick this week, less than 3 minutes!)
2. Walk-around hellos like last week, sing once, echo-sing patterns, sing again
3. Go and Stop chant with lots of movement
    a. Straight from walking hello song—on dots
    b. "Go go go" with running tiptoe feet on dots; then marching on the beat; then mix it up with non-beat movements like swimming, stretching to the ceiling or out in front like we're pulling something—not sure if your movement for singers class could give some fun ideas for this? Make sure the saying of the motion word matches the movement, so words like swim, pull, fly, etc are said long and stretched out!
    c. Finish with tiptoe feet again, use as transition to Puddles song

4. Puddles—with movement first, then moving to sitting down—whole/part/whole (with scarves)
    a. (Give out scarves during directions)
    b. Invite the kids to sing along with the puddle-splashing song while we tiptoe around the carpet, then stomp around the carpet, pretending to splash in puddles
    c. Back to dots with scarves
    d. Explain echo-singing process, then have them echo you in the rote song procedure you're comfortable with while splashing (small motions) with their scarves
    e. Tell them you are listening for strong singing voices while we splash around two more times, have them sing the whole song with you twice. You can add the incentive that if their singing voices are strong the first time, we can toss and catch the scarves the second time.

5. Scrubba Dubba with scarves—just a quick run-through of this to "clean up" after all of our puddle-splashing! If their focus is okay, you can ask kids for ideas how to scrub with the scarves. Then put scarves behind backs and trade for shaker eggs.

6. Spring!—sitting down first, then moving for last two singalongs—with shaker eggs
    a. They really loved the planting and growing thing, so we're going to go back to that this week!
    b. Ask them for help remembering what needs to happen for our "seeds" to grow into plants—then have them "plant" the shakers and grow into the

plant of their choice while they sing—make sure to invite them to sing along this week—2 times through.

c. "plant" our shakers in front of us while you review the song in rote song procedure. Be honest with them again about how practicing this way helps us get really good at a song!
d. Have them sing the whole song again, pretending to grow a garden.
e. For the last time through, have them hold onto their shaker egg, but this time have them stand up and walk around the carpet when they're singing—probably around the dots in a circle would be best for the sake of simplicity and so they're not crashing into each other!
f. Transition this standing-up spot into the beginning of freeze dance. Tell them to hold onto their shaker eggs, but that they can put them back when the music is going if they'd like to!

7. Freeze Dance (with or without shakers)
8. Goodbye Song

Weekly Music Class Lesson Plans: Week 7

Transition Week

1. Warmups and vocal roller coasters

2. Hello song as a choo-choo train!
    a. Sing twice moving around the room with you as the leader—curvy pathways around the carpet. Mention that we are looking for great singers to help lead the train for the next few music classes!
    b. Quick transition into "clackety clack," staying in same line.

3. Clackety-Clack chant and "choo choo" patterns moving around
    a. Do this chant twice, give a child a chance to be the train "leader" (with guidance)
    b. Have them echo a few "choo choo" patterns, in meter
    c. Pick a new leader and have them lead around the carpet while you chant twice

4. Spring!—with scarves
    a. Tell the kids the challenge is to see if we can give everyone a scarf by the time we sing the Springtime song two times! (Sing either without or with words, depending on class). It might also be fun to have their singing "move" you (or me) around the circle—if they are singing, we can keep giving scarves, if they're not singing, we can't!
    b. For the "without words" classes, tell them they have been doing a great job singing the melody of the Springtime song, and now we are going to "plant" something new in their brains—the words that go with the song! Their new job is to just have on their listening ears, and to quietly toss their scarves up and down as you sing the song with the words.
    c. (For the other rooms, who have been singing with words the whole time, they will still just listen and toss; just explain that they have been singing so well, but sometimes it is good to take a listening break, and get the song planted in their brain again).
    d. Sing the song two more times in a row…can even be a "freeze toss" scenario where they need to be listening well enough to stop and freeze if your singing pauses for a moment.

5. Puddles—with scarves
    a. Stay standing up
    b. Explain that this is also a word learning/planting day for the Puddles song, but that we want to practice it two times again first. This time, see if we

can c*ollect* all the scarves by two times through the song (either without or with words).

c. After all are collected, remind them that this time they are just to listen--to either hear the words for the first time or just to let them really soak in. Have them move around on tiptoe feet as silently and secretly as possible as you sing the song relatively quietly. At the end of the second time, have them gather around the rocker to hear the Jazz Baby story—probably inside the dots circle

6. *Jazz Baby* by Lisa Wheeler

a. Remind them this is the story we mentioned last week, and that they have the special job of listening for the words "Go Man, Go!" and see what kinds of music the baby's family creates

Read the story rhythmically and with swing, all sorts of inflection. When you get to the Go Man Go pages, have them echo that phrase after you.

Weekly Music Class Lesson Plans: Week 8

Both groups hear and sing all songs with text

1. Warmups and Vocal Roller Coasters
2. Hellos—Choo Choo Train setup with a few children leading
    a. Sing twice moving around the room with different children as the leader—curvy pathways around the carpet.
    b. Quick transition into "clackety clack," staying in same line.

3. Clackety Clack
    a. Do this chant twice, give a child a chance to be the train "leader" (with guidance)
    b. Have them echo a few "choo choo" patterns, in meter
    c. Pick a new leader and have them lead around the carpet while you chant twice

4. Puddles—with parachute
    a. First two times, kids just listen, watch as we model how to use the parachute, moving up and down in 2-beat increments
    b. Third and fourth time, invite children to sing along as we continue to move the parachute up and down

5. Red Umbrella with parachute and scarves—add in scarves to the middle to "dance" in the parachute
    a. Sing several times and gently (!) wiggle and shake the parachute to make the scarves dance
    b. Sing again, and this time move the parachute up and down on the third phrase—do this twice

6. Popcorn—get wiggles out and bodies ready to move
    a. Perform the chant with both big and small movements
    b. Children's ideas of what to move
    c. Echoing short rhythm patterns from you first, then we copy their rhythms
    d. Perform the chant with "my whole self" wiggling

7. Spring!
    a. With continuous movements/gestures for the song—they listen and only do gestures first two times
    b. Third and fourth time, invite children to sing along while moving

8. Goodbye song

Weekly Music Class Lesson Plans: Week 9

1. Warmups and Vocal Roller Coasters
2. Hello Song
    a. Conversational “Hello friends” tonal patterns
    b. add in rhythm sticks for beat keeping second time

3. Popcorn (with rhythm sticks)
    a. My sticks feel the rhythm! (sitting down)
    b. Rhythm patterns with voices and sticks
    c. Sticks and feet feel the rhythm

4. Spring!
    a. Sing twice with movements, pretending to “grow in the garden”
    b. Echo tonal patterns
    c. Sing twice again with movements—grow into a different plant this time!

5. Here is the Beehive with parachute
    a. Let a few kids at a time lay under the parachute while we stand and hold it, walking around in a circle
    b. Lift the parachute at the end of the chant

6. Puddles with parachute and scarves
    a. Same as last week, but they can participate the whole time—immersion/singalong
    b. Sit down with parachute; lift up and down or shake gently while echoing tonal patterns
    c. Two more times, immersion/singalong

7. Guided movement—listen for the animals they sing about in “Animalés,” and see if you can move like that animal (standing up, though!)

    English Words:

    In the jungle are many creatures, many creatures, many creatures,

    In the jungle are many creatures, many creatures, many creatures

    Elephants, big elephants, gorillas there, gorillas there,

    And slinky snakes, and slinky snakes, and lions too

    Elephants, gorillas there, and slinky snakes and lions too!

8. Goodbye Song

Weekly Music Class Lesson Plans: Week 10

1. Warmups: movement music—Animalés (Spotlight on Music, Kindergarten)
    a. Guided movement—listen for the animals they sing about in "Animalés," and see if you can move like that animal (standing up, though!)

    English Words:

    In the jungle are many creatures, many creatures, many creatures,
    In the jungle are many creatures, many creatures, many creatures
    Elephants, big elephants, gorillas there, gorillas there,
    And slinky snakes, and slinky snakes, and lions too
    Elephants, gorillas there, and slinky snakes and lions too!

2. Vocal Roller Coasters

3. Hello Song—changing tempi—slow to fast and fast to slow, hellos to Largo, one more time to receive scarves

4. Puddles (m3)—with scarves only, focusing on child singing participation and cueing them in with a descending tonic triad
    a. Drawing circles with scarves—1 time
    b. Echoing each phrase of the song one time (just two measure phrases, no four measure repeats)
    c. Singing "by themselves" 2 times—no teacher singing, only kids—probably pressing for "a little louder" the second time
        (new surprise to follow!)

5. Teddy Bears! (m2)—with scarves and teddy bears
    a. I have 4 small teddy bears (super soft, so will need to budget a minute for letting them hug on them)
    b. Model first with you and I—either one of us can hold the teddy bear, and the other put a bunch of scarves over it so it is "hiding"…and then we pop it out of the scarves at the very end of the song on "now!"
    c. Give teddy bears to four teachers/interns around the room and group some kids around them, play again with the small groups covering up the group's teddy bear and the teacher popping the bear out at the end
    d. Tell them they will get to hold the bears next week

6. Go and Stop (2)—move like various animals—no kiddo suggestions today, just a mixture of moving at different levels in space (high/low/medium) and different speeds. So, maybe: Bears, Turtles, butterflies, fish, bouncy frogs, etc?

   a. Transition to this by having them turn into “baby bears” themselves
   b. Move through different animal choices—you can ask them HOW they would move for each animal, but just to show you and not explain for the sake of time

7. Springtime (M2)—with motions, again focusing on child singing participation and cueing them in with descending tonic triad
   a. Transition to this by having them sing the pretend to be baby birds again while singing/listening to the Springtime song one time—moderate tempo, a little faster than before
   b. Echo sing each phrase of the song one time while having them copy generalized motions they’ve come up with (so just each 2 measures once, no four measure repeats this time either)
   c. Ask them to “perform” this song all by themselves 2 times—the stronger and more beautiful their singing voices, the more we can clap for them!

8. Freeze Dance
9. Goodbye song while lining up

Weekly Music Class Lesson Plans: Week 11

1. Warmups
    a. A few quick stretches and wiggles
    b. Vocal roller coasters

2. Hello Song and echoing tonal patterns—loud and quiet, either tiptoeing or marching around
    a. Turn on waving hands, etc.
    b. Mention how last week we played with singing faster and slower, and that another way to change how music sounds is to make it louder or quieter!
    c. Tiptoe and sing (quiet, but still singing!)
    d. March and sing (louder, but not yelling!)
    e. Changing from loud to quiet as we go back to our dots

3. My Mother, Your Mother—they get to pick sticks or eggs
    a. Recruit teacher help to send kiddos to stick bucket and egg bucket
    b. Tell the kids they can either pick two sticks or two shaker eggs
    c. Chant "my mother" on neutral syllables while they do that, including sample rhythm patterns
    d. Chant one time and have them echo my patterns—tell them before it will be their turn soon to make the rhythms, so be thinking! Echo with voices and/or instruments
    e. Chant a second time and take volunteers for patterns—then "be sneaky" and put instruments behind backs
    f. Chant a third time "like a secret" in a whisper voice, do patterns in a shushing sound

4. Quick deep breathing while teachers help me collect
    a. Reminder that nice deep breathing helps us be amazing singers
    b. Breathe and "shhhhh"
    c. Breathe and "yawn"
    d. "Quietest breathers"

5. Special songs disclaimer–tell the kids that two songs that have been really special in music class with Ms. Kendal are the springtime song and the puddles song, because I wrote them to help me learn about how kids sing! Tell them if they sang with me in the microphone before, they will get to sing these special songs into the microphone this week, but that we need everyone's help to practice. To make it extra wonderful, we get to take turns playing on the bells gently with the songs. (have bells in the center and call kids 4-5 at a time to play) Model how you can sing and tap gently on the bell at the same time.

6. Springtime with bells on tonic—just sing twice (1 minute)—groups 1 and 2 play bells, everyone sing

7. Puddles with bells on tonic—just sing twice (1 minute)—groups 3 and 4 play bells, everyone sing

8. Scrubba Dubba with scarves—maybe let them pick their color—chant several times standing up

9. Teddy Bear with Scarves—sit down in small groups with the bears

10. Freeze Dance—scarves if they want them

11. Goodbye Song

APPENDIX D

Publisher Permission and Study Songs and Chants from *Music Play*

Hi Jessica,

We are happy to grant you permission to include the requested songs in your dissertation, provided that you cite your sources according to your house style. The attached Word document lists the songs and their source publications. I was not sure which Popcorn chant you used, so I identified both sources.

This message may serve as a written record of your permission. If you require a more formal record of permission for your files, please let me know.

Best,

…

Kyle

Kyle Cothern
Associate Permissions Editor

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Chants:		
1. Popcorn (D. Johnson / W. Valerio)	© 1998, GIA Publications, Inc.	Music Play
2. Here is the Beehive	Traditional	Music Play
3. Clackety-Clack (D. Johnson / W. Valerio)	© 1998, GIA Publications, Inc.	Music Play
4. Go and Stop	Traditional	Music Play
5. My Mother, Your Mother	Traditional	Music Play
6. In the Tub (Scrubba Dubba) (D. Johnson / W. Valerio)	© 1998, GIA Publications, Inc.	Music Play
7. Rolling (W. Valerio)	© 1998, GIA Publications, Inc.	Music Play

Songs:		
1. Red Umbrella (E. Gordon)	© 1993, GIA Publications, Inc.	Experimental Songs and Chants, Book 1
2. Stirring Soup (W. Valerio)	© 1998, GIA Publications, Inc.	Music Play
3. Teddy Bear (B. Bolton)	© 1993, GIA Publications, Inc.	Experimental Songs and Chants, Book 1
4. (Look) To the Window (J. Kahan / A. Reynolds)	© 1998, GIA Publications, Inc.	Music Play

APPENDIX E

Posttesting Procedure

1. Have child sit down with Largo/Teddy Bear, and in front of microphone.

2. "_____. I'm so glad you're here! This will be fun. Remember how a long time ago we made a recording of Twinkle, Twinkle for Largo by singing into this microphone? Well, today I'm hoping we could make some great recordings of our "Spring" and "Puddles" songs. Is that okay?"

3. Click to Audition file and unmute the microphone; make sure to label the file.

4. Press record and say: "_____, Let's warm up with some star songs first! (play bell to set tonic) Will you sing these after me? My turn first (then sing each on "bum": do-mi, sol-mi-do, sol-fa-re-ti, and finish with do-mi-do)."

5. "Wonderful! Now we get to make the special recording of "Spring" for Largo. I'll go first." (Play bell and sing "here I sing" on sol-mi-do, then sing through Spring once, showing singing right toward the microphone).

   "Now it's your turn! (Play bell and sing "here you sing" and record their singing)

6. "That was great! Let's do the same thing for the "Puddles" song. Sing after me:" (Sing the same functional tonal patterns, but in minor this time) "Great! Okay, my turn to sing the Puddles song." (Sing "here I sing," then sing through "Puddles.")

   "Now your turn!" (play bell and sing "here you sing," record their singing.)

7. Press pause, **save the file**, cheer for them and thank them, and ask them to give Largo some big hugs if they'd like to on the way back to their classroom.

APPENDIX F

Raw Data Set

	Audie	BSCSVU	SVU Maj	SVU Min	SVU Com	BSCPAP	PAP Maj	PAP Min	PAP Com
Control									
101	7	5	5	4	4.5	0.83	0.75	0.15	0.45
102	8	5	4.5	5	4.5	0.71	0	0.4	0.2
103	7	5	4.5	4.5	4.5	0.71	0.1	0.4	0.25
104	8	5	5	5	5	0.91	0.3	0.8	0.55
105	6	4.5	4.5	4.5	4.5	0	0.05	0.2	0.13
106	4	3.5	2.5	3	2.5	0	0	0	0
107	9	5	4.5	3	3.5	0.19	0.15	0.05	0.1
108	3	4.5	3.5	2	3	0.41	0.05	0.05	0.05
109	9	4	5	4.5	4.5	0	0.2	0	0.1
110	5	5	5	2.5	3.5	0.52	0.2	0.05	0.13
111	5	1.5	5	4	4.5	0	0.15	0.25	0.2
112	9	5	5	4	4.5	0.83	0.55	0.03	0.29
113	2	1	3.5	1	2	0	0	0	0
Intervention									
114	6	2.5	2	2	2	0	0	0	0
115	7	5	5	5	5	0.29	0.4	0.25	0.33
116	4	2.5	2	1	1.5	0	0	0	0
117	5	2.5	4	4	4	0	0.05	0.05	0.05
118	9	5	5	5	5	0.41	0.25	0.1	0.18
119	5	3.5	5	4	4.5	0	0.2	0.25	0.23
120	9	1	4.5	3.5	4	0	0.2	0.1	0.15
121	2	5	4.5	2.5	3.5	0.76	0.15	0.05	0.1
122	9	1.5	5	4	4.5	0	0.1	0.1	0.1
123	8	5	5	4.5	4.5	0.38	0.45	0.2	0.33
124	4	5	5	4	4.5	0.76	0.25	0.2	0.23
125	10	3	3	2	2.5	0.1	0.05	0.1	0.08
126	6	4	4.5	4	4.5	0.12	0.3	0.25	0.28
127	5	1	3	2.5	3	0.02	0	0.1	0.05
128	9	5	5	4.5	5	0.05	0.6	0.45	0.53
129	5	5	4.5	4	4.5	0.43	0.05	0.05	0.05

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