EFFECTS OF GENDER AND AGE ON VOCAL MODELING AND THE PITCH-MATCHING ACCURACY OF ELEMENTARY SCHOOL CHILDREN

A Thesis
Presented in Partial Fulfillment of the Requirements for
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This study was conducted to determine the effects of gender and age on vocal modeling and the pitch-matching accuracy of young children. Ninety-three students in grades one through five were tested on their ability to respond vocally to one of three different vocal models. Of the 93 participants, 53 were female and 40 were male. The vocal models included a child female, a child male, and an adult female.

All participants were asked to watch a video-taped recording of one randomly chosen vocal model. Each participant was asked to respond vocally to a set of random melodic phrases from the song "Are You Sleeping?" on the neutral syllable "loo." Then, the participants listened to "Are You Sleeping?" sung on text. Finally, each participant was asked to echo the phrases of the song as provided to them using the rote-song approach. All vocal responses were recorded and later examined for their pitch-matching accuracy by the researcher. These accuracy ratings were tested against a group of judge's ratings to account for reliability.

While the vocal model made no significant impact upon the vocal accuracy of the participants, the gender of the participants and the text method did. The females sang significantly more accurately than the males for both sections of the study, and both gender groups sang significantly more accurately using the neutral syllable "loo" rather than the text. These results may indicate that the song-learning approaches
elementary general music teachers use in their curriculums may need to be re-examined.
To Martin
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CHAPTER 1

INTRODUCTION

From the time I was a little girl, I knew that singing would always be a part of my daily activities. I was a founding member of Kinderchor at Otterbein College. I sang in Choir Plus for 5 years at my church. I was a first soprano in the top select choir at my high school by my junior year, and my choir director gently nudged me into thinking about majoring in music. With the help of a few voice lessons and the support of my family, I auditioned for The Ohio State University School of Music and was offered a scholarship and admittance for September of 1996.

When I matriculated in music, I was absolutely convinced that I would specialize in choral music and become the world’s greatest high school choral director. That all changed when I embarked upon my student teaching experience. After walking into a first grade classroom and receiving hugs, smiles, and unbelievable enthusiasm for a lesson on quarter notes, I was hooked. I knew where I wanted to teach, where I should teach, and that I would never stray from elementary music.

With this determination, I received my first position as the traveling elementary general music teacher for a rural school district just east of Cincinnati.
Ohio. I had the privilege of sharing a classroom with several fine veteran music teachers. I learned so much from them. It was especially interesting to watch how my students vocally responded to me, each other, and to the other teachers, one of whom was male.

I became intrigued by the effects of both gender and age on a child’s individual ability to vocally respond. The majority of my students tended to reach into their lower vocal registers in an attempt to match pitches sung to them by the male music teacher. In addition, my female students usually responded more accurately when modeling a child female singer rather than a child male singer. The same was true for my male students.

These observations lead to more study concerning factors surrounding children’s pitch-matching abilities. Before diving in, I completed a broad overview of the research done on vocal modeling and pitch-matching accuracy with young children. I soon realized that while there was an abundant amount of research dealing with an adult male vocal model versus an adult female vocal model and child vocal models, there was a definite lack of studies comparing the difference between a child male vocal model and a child female vocal model. As I had experimented with child modeling in my previous teaching experience with mixed results, I chose to explore this avenue further.

The following study evaluates the effects of gender and age on vocal modeling and the pitch-matching accuracy of young children.
CHAPTER 2

REVIEW OF RELATED LITERATURE

Singing is one of the most studied topics in music education. Music researchers and educators alike constantly strive to find new methodologies and approaches to improve vocal techniques for use in the classroom. Although many sub-topics are included in research about singing, both vocal modeling and pitch-matching accuracy claim a high volume of studies. Of these studies, most have focused upon the effect of adult male versus adult female vocal modeling, methods of teaching children to match pitch, and the circumstances under which children sing most accurately (Aitchison & Phillips, 1997; Apfelstadt, 1984; Brophy, 1997; Goetze, 1989; Green, 1987; Hickey, 1996; Mathias, 1997; Odom, 1991; Tatem, 1992). The studies that have focused upon child vocal modeling have compared group versus individual singing (Goetze, 1989; Green, 1987; Sinor, 1990).

While a fair amount of research has been centered on the specifics of vocal modeling and pitch-matching accuracy, several important studies offer a broader spectrum of information about children’s singing. Goetze, Cooper, and Brown (1990) presented a 25-year overview of research on children’s singing. The first section focused on papers that examined the broad picture of singing in the general music
classroom and included a specific emphasis on reported singing inaccuracy. This section segued into studies that examined the required processes for accurate singing, and the third section compared different approaches for achieving success with children’s singing. The overview concluded with a presentation of problems and extended suggestions for future research.

With great detail, this overview asserted that many of the studies concerning children’s singing have developed problematic trends. These trends include the actual task utilized for assessing singing, such as melodic patterns versus entire songs and neutral syllables versus text; the number of assessments and familiarity with the testing procedures; the measurement of singing responses; and the methods of assessing pitch accuracy. To work towards solving these problems, Goetze, et al. (1990) offered the many conclusions and suggestions. Some of those which had the biggest impact on this study were:

1. Age affects a person’s singing ability;
2. The timbre and the pitch of the vocal model are extremely important for both research and the teaching of general music;
3. The reviewed studies contradict each other when presenting the most accurate sung intervals among child singers;
4. Research is too conflicted to determine whether children sing more accurately with or without text;
5. There is no conclusive evidence concerning harmonic accompaniment and its effect on children’s singing;
6. Young children’s vocal accuracy may be affected if they sing alone or in a group;  

7. If children receive positive feedback when singing, they may respond with a higher rate of pitch-matching accuracy;  

8. Inaccurate singers do benefit from vocal instruction.  

This overview is an excellent guideline for research on pitch-matching accuracy prior to 1990. It is thorough and well-organized. In describing different factors affecting vocal accuracy, the authors categorize the research into the following groups: modeling, characteristics of singing task, text, differences in individual and group singing, accompaniment, and special training programs (Goetze, et al., 1990). Several of the studies listed had an important impact upon the organization and realization of my research.  

In a more recent study, Guerrini (2002) strove to determine the development of the singing voice in elementary school students. More specifically, this study focused on the developing voices of fourth and fifth graders in a suburban, middle-class community. Guerrini tested the following issues: the effects of different singing tasks on vocal accuracy; which tonal characteristics are most associated with difficulty in pitch accuracy; and how children’s gender and tonal aptitude affect their singing success. The students were recorded performing three separate tasks: singing vocal patterns; a newly-learned song; and a familiar song.  

Guerrini found that children’s vocal abilities were not nearly as accurate while singing vocal patterns when compared to singing the two different songs. The differences in vocal accuracy between each song, new and old, were not significant.
Children with higher musical aptitudes, however, were significantly more vocally accurate than children with lower musical aptitudes. The conclusion focused on gender and claimed that female students were generally more successful in all of the singing tasks.

Accuracy comprised the focus of another intriguing study on children’s singing. Hickey (1996) focused on the comparison of children’s singing accuracy when presented with diatonic and pentatonic vocal patterns within both ascending and descending lines, in familiar and unfamiliar music. Hickey tested a group of students in grades one through six with eight different melodic patterns. All of the participants were drawn from the same elementary school.

Although the research showed that the students sang the pentatonic patterns more accurately than the diatonic ascending and descending lines, Hickey’s other results were statistically insignificant and somewhat inconclusive. Possible reasons for this may include: the age range of the students; the possible auditory confusion due to the numerous vocal patterns offered; and the difference in difficulty of the vocal patterns. Hickey recommended that music educators should use care in selecting literature for children to sing, as these selections may play a large factor in determining the vocal accuracy of the students.

Rather than examining accuracy, Welch (1998) chose to focus on the significance of proper singing technique for young children. Welch, a Music Education Professor and Head of the School of Arts and Humanities at the University of London’s Institute for Education, has published many studies on the implications of quality voice instruction for preschool students and students with special needs. In
an article entitled “Beginning Singing with Young Children,” Welch identified three main conditions that contribute to “poor pitch singing,” which are: faulty ear training, poor vocal control, and an innate lack of musical ability.

Welch defined uncertain singers as “clients for development” and explained that vocal pitch accuracy will only improve if the child’s environment requires an improvement. Three objectives that were considered to be vital in helping a child reach better singing accuracy include: use of a limited pitch range; use of variations in singing tasks; and the provision of meaningful feedback to the child. Welch recommended an octave range, either G3-G4 or A3-A4, and the use of glissandi and games, such as “pulling the notes from the ceiling with elastic.” The glissandi allow the children to explore pitch without failure and provide a release of muscular tension.

When working with song variety, Welch proposed that children be allowed to explore many different avenues of music. The researcher also inferred that children’s pitch-matching skills improve more rapidly with practice. Finally, Welch recommended meaningful feedback for the young singer. A child must make sense of the task he or she is given. Children cannot correct what they do not understand is wrong.

While other studies have mirrored some of the above suggestions for the improvement of children’s vocal pitch accuracy, it is interesting to note that Welch is one of the only researchers that specifically tested positive feedback. From observations of my own peers, I have come to believe that many inexperienced teachers tend to give little, if any positive feedback to their students. Welch’s
findings indicate that encouragement has a significant effect on accurate singing. Future research in children’s vocal pitch accuracy should explore this possibility.

Although a broad spectrum of knowledge is necessary for any educational research topic, some of the most enlightening studies have developed from more specific questions. Addo (1998) examined the relationship between tone production and language, specific to children from Ghana. The study had two separate stages. First, a Ghanaian folk song, “Obiara,” was taught to children in a Ghanaian primary school. This stage was continued by teaching the same song to children in the King Jumpie School of England. The final stage involved the researcher collecting and analyzing the data.

The results of the first stage showed that linguistic content did influence musical ideas, especially melodic movement. The author inferred that the language a child speaks affects his or her ability to accurately perform melodic contour. Since singing development occurs largely through play and cultural activities, Addo advocated that vocal development should be encouraged simultaneously with exercises that are rooted in a child’s culture. Addo concluded by making vocal pedagogy advice based on the results. These recommendations centered on vowel shape, dynamics, recording and listening, and encouraging a child’s ability to audiate music by asking him or her to “drop pitches.”

While the results of this stage are somewhat encouraging, it is difficult to reach a general conclusion without the outcome of the last stage. The introduction to this study is somewhat misleading, as it appears to offer a final comparison between
the English and Ghanian students. That comparison was not given until the second stage of the study, and as such, it does not exist in Addo’s article.

A similar study concerning text use and children’s pitch-matching accuracy was administered by Gault (2000). This study asked four main questions:

1) Would differing pedagogical approaches effect kindergarten and first-grade students’ abilities to sing a major duple song with tonal and rhythmic accuracy?

2) Would the inclusion or omission of text during the teaching of the song affect their overall accuracy?

3) Would an individual child’s music aptitude have a role in determining the effectiveness of a pedagogical approach and the child’s song performance ability?

4) Would the grade level of a child affect his or her singing accuracy?

Before the study was administered, an initial test was given to eight different classes, four of Kindergarten and four of first grade. The children learned two different folk songs through randomly assigned methods, which included: learning entirely with text, learning entirely without it, phrase learning with text, and phrase learning without it. The experiment lasted eight weeks – “Song One Performance” was recorded during week four and “Song Two Performance” was recorded during week eight. Gault found that the first song was most affected by text. The students’ performances improved when text was included. Students with higher music aptitudes generally performed better than those with low aptitudes, but the low aptitude students’ performances improved through the echo-phrase method. This
mirrors Welch’s assertion that uncertain singers can improve with directed approaches.

Even though children may respond better vocally to certain timbres, texts, or sounds as Addo and Gault found, there are many different methodologies that may also assist with pitch-matching accuracy. In the dissertation entitled “Effects of Melodic Perception Instruction on Pitch Discrimination and Vocal Accuracy of Kindergarten Children,” Apfelstadt (1984) assigned 61 students to three different instructional settings for eleven weeks. The first group of students received vocal instruction designed to promote melodic perception through visual and kinesthetic reinforcement. Group two students received vocal instruction through imitation, and the third group of students received a traditional, non-conceptual approach to their education. Her findings indicated that:

1. No differences were present in auditory discrimination;
2. Significant differences were present for vocal pitch-pattern accuracy between groups one and three and groups two and three;
3. Groups two and three differed significantly in their rote-singing abilities.

Apfelstadt felt that children may need to have a basic understanding and visualization of melodic contour for successful singing. Inconclusiveness may have resulted from structural reliability factors, the length of the study, and the limited number of participants. Future research dealing with melodic contour and vocal pitch accuracy is needed.

Kim (2000) utilized another kinesthetic approach to find a connection between movement activities and children’s singing ability. The study compared three groups
of first graders. Group A received singing instruction through movement; Group B received the same singing instruction without movement; and Group C received no singing or movement activities. Each group received 30 minutes of music instruction for ten weeks. Kim made the following conclusions:

1. Sequential music activities have a positive effect when developing children's singing voices and sense of tonality;

2. Movement activities and music activities are beneficial to child singers when presented together in a set sequence.

3. A child’s score on the Primary Measures of Music Audiation Test is likely not to improve with ten weeks of music instruction for only 30 minutes per week.

4. The need for consistent and high-quality singing experiences among first-grade children was emphasized by the obvious lack of improvement in children's development of singing voices and sense of tonality for children in the control group.

These conclusions make several generalizations about the effects of music instruction, which Kim extrapolates from her own study. It calls into question whether the sample size is large enough to make those generalizations.

Also intrigued by vocal teaching methodologies for young children, Sinor (1984) developed a study, entitled “The Singing of Selected Tonal Patterns by Preschool Children.” Sinor wanted to determine the validity of several conjectures about children’s singing made by previous music educators. Some of these postulations include the idea that children should learn the “sol-mi” interval first as it
is easiest to sing, and advocating the use of the pentatonic scale because young children cannot sing half-steps in tune. Forming a subject group of ninety three-, four-, and five-year-olds, Sinor presented twelve randomly selected vocal patterns to the children and had them echo these on a neutral syllable. Based on analysis of the data collection, the following conclusions emerged:

1. Whole steps or thirds were similar in singing difficulty to half-steps.
2. Vocal patterns that contained all stepwise motion and thirds were generally sung more accurately than patterns containing sixths.
3. The majority of all age groups performed the descending minor third with the most ease.
4. Only partial support can be given to the hypothesis that descending patterns are easier to sing than ascending ones.
5. Successive leaps in the same direction did not have a consistent effect on song performance ability.
6. Children’s ability to echo-sing patterns may be affected by other factors not examined in this study, such as familiarity with a pattern.

Sinor reasoned that her study lent limited support to the relative easiness of vocal descending patterns, and also that it helped show that successive leap singing does not always negatively affect children’s vocal accuracy. Sinor’s conclusions were vital to the development of vocal pattern testing for this study.

Flowers and Dunne-Sousa (1990) furthered the research on children’s ability to accurately match vocal patterns while remaining in a tonal center. Their study, entitled “Pitch-Pattern Accuracy, Tonality, and Vocal Range in Preschool Children’s
Singing” centered on preschool children, ages three to five. Each child was tested individually by singing a self-selected song, singing a taught song, and echoing 20 short pitch patterns. While also exploring the effects that age had on a child’s ability to produce a pitch accurately, Flowers and Dunne-Sousa made the following conclusions from their research:

1. Children more accurately echoed melodic contours than correct pitches or intervals;
2. A low positive correlation was found between ability to echo pitches or contours and maintenance of a tonal center in singing;
3. Children consistently used larger vocal ranges in echoing pitch patterns than in singing songs.

Drawing evidence from this study and others, Flowers and Dunne-Sousa made many suggestions for future research in the area of vocal accuracy. During their final analysis and discussion, they noted that when children were unable to sing a lower note, it was perhaps due to their vocal range restrictions. When children missed higher notes, however, it seemed to be caused by their lack of effort to stretch their voices. It is the researchers’ opinion that in order to provide children with the ability to use their vocal ranges to their fullest potential, proper vocal pedagogy must be taught in their classrooms.

In addition to achieving pitch-matching success with certain syllables or sounds, it has been asserted that children may respond with more vocal accuracy to certain types of instruments or timbres. Using a group of 91 children between the ages of three and five, Ramsey (1983) analyzed the effects of age, singing ability, and
instrument experiences on preschool children’s auditory perception of five melodic components: absolute pitch level; melodic rhythm; melodic contour; tonal center; and melodic interval. This study showed that:

1. Significant differences associated with age were found in their perception of melodic rhythm, contour and interval;

2. High-ability singers scored higher than low-ability singers on perception of melodic contour, center, and interval;

3. Instrumental and non-instrumental treatment groups did not differ significantly in perception of any of the melodic components.

No conclusive evidence was found that showed improvement over time of absolute pitch level or tonal center, or for proving that experiences with pitched instruments enhance children’s perceptual abilities. Ramsey, however, did assert that singing ability does affect the preschool child’s capacity to demonstrate melodic perception through vocal response.

Many researchers have conducted studies on the specifics of vocal pitch-matching accuracy in children. One hypothesis that has been presented for improvement of pitch accuracy involves letting children sing songs on a neutral syllable, such as “loo,” rather than forcing them to sing the text. The neutral syllable approach has been the focus of much research, but two of the more intriguing studies were administered by Goetze (1985) and Levinowitz (1989).

Goetze, a music educator interested in children’s choral singing, designed a doctoral dissertation to examine both the strength of students’ individual singing and their accuracy when singing with a neutral syllable. A group of 165 students in
grades Kindergarten, One and Three were asked to learn two similar melodic phrases. Then, each subject was requested to sing one of these melodies individually and also in a group by imitating the researcher’s voice. Both text and the neutral syllable “loo” were used for the procedure. By using their recorded responses, Goetze determined that:

1. The subjects sang more accurately individually;
2. The subjects collectively had more accurate pitch with the syllable “loo;”
3. The subjects sang most accurately individually on “loo;”
4. The K and 1st grade subjects benefited most from singing on “loo;”
5. The 3rd grade subjects were generally more accurate overall;
6. The female subjects were generally more accurate, especially with group singing;
7. The difference in the male subjects’ individual singing versus their unison group singing was greater than that of the female subjects.

The resulting dissertation, entitled “Factors Affecting Accuracy in Children’s Singing,” was considered truly ground-breaking research. The Music Educators National Conference and Council for Research in Music Education subsequently named it Outstanding Dissertation of 1985. As with the vocal pattern study from Sinor, Goetze’s syllable research had a huge impact on the evolution of this experiment.

Levinowitz (1989), intrigued by Goetze’s work, decided to transfer neutral syllable singing to pre-school children. For this study, a group of 35 children between the ages of four and five tested the belief that rote songs should be taught to
children without text. The results differed from Goetze’s. Levinowitz was unable to conclude that a relationship exists between language development and pitch accuracy. Therefore, in an article entitled “An Investigation of Preschool Children’s Comparative Capability to Sing Songs With and Without Words,” Levinowitz recommended that young children should be taught rote songs using both approaches.

Although these findings are noteworthy, it should be recognized that the sample size for this study was much smaller than Goetze’s. Levinowitz tested 35 preschool aged children, while Goetze tested 165 children from an elementary school. The gap in the number of participants and the participants’ learning environments may explain why their results were so different.

Tatem (1992), drawing on Ramsey’s work with musical perception, hypothesized that children may have difficulty matching pitch accurately if they are given inadequate models. The dissertation, entitled “Effects of Selected Timbres, Tasks, Grade Level, and Gender on Vocal Pitch-Matching Accuracy of Kindergarten through Third Grade Children,” investigated how different sounds affect children’s ability to match pitch. Utilizing the oboe, piano, resonator bells, soprano voice, trumpet, and violin, Tatem administered a pitch-matching test to 111 subjects.

While it came as no surprise that the students responded most accurately to the soprano voice, Tatem made a startling discovery with the resonator bells. These bells, used quite often in elementary classrooms, have fundamental frequencies that sound an octave higher than the desired tone. When trying to echo the bells, children surprisingly attempted to match the higher octave, usually causing them to fail. Tatem proposed that the children’s vocal reaction to the resonator bells could have
been due to their inability to aurally distinguish between the actual note and its overtones.

Aitchison and Phillips (1997) were also concerned with children’s aural pitch discrimination skills. They set out to determine if inaccurate third grade singers had differing abilities in pitch discrimination and tonal aptitude than those of accurate third grade singers. The study included a brief review of literature focusing on research that both confirmed and denied a connection between accurate singing and aural pitch discrimination.

The study concentrated on 72 subjects in the third grade from a small Midwestern community. Students were taught a folk song, “Pinto Pony,” over a period of one month. Once it was determined that they were all comfortable enough to sing the song by memory, they performed it for both researchers who then deemed their singing accurate or not accurate. The researchers’ overall results showed that the only significant difference could be found in tonal aptitude, favoring the accurate singers. Aitchinson and Phillips advised that the results show that inaccurate singers are not “tone deaf.” While these results did not prove a definite connection between accurate singing and aural pitch discrimination, it was proposed that they are both skills that can be learned.

Rather than centering a study on pitch discrimination, Brophy (1997) chose to determine the validity of singing games as assessment for vocal pitch accuracy. A group of children in grades one through three were given four singing games to learn. All four of the singing games contained solos. Two of these games tested the “do-re-mi” intervals and two tested the “sol-mi” interval. All students sang and played the
game and took turns singing the solo, which were then assessed by the classroom teacher. The teacher marked the solos “+” for accurate singing or “-” for inaccurate singing. The researcher took these assessments and made up three categories of singers: consistently accurate (2 +’s); consistently inaccurate (2 –’s); or inconsistent (1 + and 1 -).

Drawing from the results, Brophy determined that the data showed that musical games are reliable indicators of pitch accuracy, although one single game should not be used as an indicator for all pitches. Brophy recognized that children enjoy games, and that they appeared to sing alone more easily and confidently in this setting. The researcher cautioned, however, that the teacher doing the study must mark the singing accuracy of the soloists quickly and know the students well.

Fortunately, an abundance of research has been done on the specific effects of gender and vocal modeling on the pitch-matching accuracy of elementary children. A compelling study on modeling was conducted by Green (1990). In “The Effect of Vocal Modeling on Pitch-Matching Accuracy of Children in Grades One Through Six,” Green explored effect of adult male, adult female, and child modeling on young singers. On three separate occasions, a large group of students was tested for pitch-matching accuracy, each time with a different model.

The results indicated that the type of model had a significant effect on the accuracy of students’ vocal responses. The child model garnered the most accurate singing, followed by the adult female, and then the adult male. Interestingly, Green also took notice of which sixth-grade students in the study were involved with band and chorus. After a correlation of responses, it was found that band members sang
more correct responses than chorus members. The band members also produced the
most correct responses when modeling the adult male.

Odom (1991) was concerned with the effect of male vocal modeling on
children’s singing voices. While much research has been done on the positive effect
of similar voice modeling pertaining to children’s vocal accuracy, there is a noted
lack of studies dealing with male modeling, both in their normal voices and when
singing in falsetto. After gathering research and discussing this problem with his
colleagues, Odom developed a test that might show the effect of different types of
vocal models on the pitch-matching accuracy of children. The subjects were given a
pre-test and a post-test asking them to follow the vocal patterns of either a female
vocal model, a natural voice male model, or a falsetto voice male model.

Odom concluded that children definitely respond most accurately to a female
vocal model, followed by a male falsetto model, and finally a male natural voice
model. The author counseled that more research be done in this area, and also
asserted that more literature should be introduced that provides concrete examples of
good vocal modeling.

This review has explored research that spans the most general information
concerning children’s singing to the very specific effects of vocal modeling on
children’s vocal pitch-matching abilities. Much of the research presented has offered
suggestions and possible future implications for music educators. Specific
pedagogical methodologies were also discussed. The following study reinforces
previous research by specifically examining the effects of gender and age on vocal
modeling and the pitch-matching accuracy of young children.
CHAPTER 3

METHODOLOGY

Ninety-three students in grades one through five were tested on their ability to vocally respond in imitation to different models presented both visually and aurally. Of the 93 participants, 40 were male and 53 were female. Students were randomly split into three separate groups, and each group contained 31 participants. All of the groups had each grade represented. Within those grades, at least one child of each gender participated (see Figure 3.1). Group I had the most even representation of gender, while the females in Group III doubled the males (see Figure 3.2).
Figure 3.1: The gender, grade, and number of participants.

Figure 3.2: The gender ratio for each grade.
All participants were drawn from the same elementary school in a suburban district near Columbus, Ohio. This school contained students from mostly Caucasian, Midwestern, middle, and upper-middle socioeconomic families. The majority of parents in this community have received some level of college education. Along with their regular education, all students at this school attend a general music class at least once every week for varying amounts of time. The general music teacher integrates Kodály, Orff-Schulwerk, and Dalcroze methodologies on a consistent basis in the classroom.

Students participated on a volunteer basis only, and no set class structure was used for determining their participation. Permission was obtained from the principal of the elementary school involved, the participants’ parents, and the affected general classroom teachers. Permission letters were distributed during the students’ music time and were usually returned to the general classroom teacher (see Appendix B).

Prior to the experiment, an application for exemption was completed and filed with The Ohio State University Behavioral and Social Sciences Institutional Review Board. Permission to proceed with the experiment was granted on April 22nd, 2004 (see Appendix A).

For the experiment, three vocal models were used: a child male; a child female; and an adult female, who was also the researcher. All vocal models were videotaped using a Canon TR45 Digital Video Camcorder. The researcher videotaped the child models, and the researcher was videotaped by a trusted adult with prior experience handling the camera equipment. All models were videotaped in
a small classroom adjacent to the school’s general music room. Only the researcher and the model being taped were present in the room.

The child vocal models were chosen from a neighboring elementary school through the recommendation of their general music teacher. It was decided that a vocal model with whom the participants were too familiar would cause a disruption in testing reliability. The adult female model had little previous contact with the participants. Parental permission was obtained for the child vocal models’ participation (see Appendix A).

Each vocal model was asked to perform three tasks in the following order: sing four vocal patterns extracted from a chosen song on a neutral syllable; sing through the same song; and then repeat the song with metric pauses to allow for the participants to respond. When the vocal models had trouble during the videotaping, the recording was stopped and then started anew. This process continued until the quality expectations of the researcher were met.

The neutral syllable used for the vocal patterns was “loo,” and all vocal patterns were sung randomly rather than in song order (see Figure 3.3). The song used was “Are You Sleeping?” and was sung in English (see Figure 3.4). This song was selected on the recommendation of the subjects’ elementary general music teacher, who conjectured that most of the participants would have heard the melody at least once. Both researchers recognized the importance of having a relatively familiar but not completely known song to test vocal pitch accuracy with vocal models.
Once the videotaping of the vocal models was completed, the co-researcher worked with the elementary general music teacher to set up a testing schedule. Some testing was done during the participants’ music class time while other participants were pulled out of their regular classroom with the permission of their teachers. All testing was completed within the span of two weeks. Because of illnesses, several participants were tested at a later date than originally scheduled. Before a student was tested, two permission letters had to be presented: the initial one showing the parents’ consent for their child to be tested; and the latter for the child to be audiotaped (see Appendix A).

The testing was done in either the music classroom or a small audio-visual room. In the music classroom, a 26-inch television was used to show the vocal
models; and in the audio-visual room, a 17-inch television was used. While the smaller television was the only one available during testing times, no difference in quality of sound or pitch was noted. Only the researcher and the participant were present in the room.

When a participant entered a testing room, he or she was randomly placed into three different groups: Group I responded to the child male model; Group II responded to the child female model; and Group III responded to the adult female model. All participants were asked to either sit or stand according to their own preference. If they sat, they were requested to maintain good singing posture. This posture was then monitored and occasionally corrected by the researcher.

Before playing the videotape, the students were told by the researcher that they would see and hear a person singing on the television screen. An example script is presented as Appendix C. As the videotape progressed, the participants’ vocal responses were audio-taped using an Eiki Cassette Tape Recorder, Model 5090A.

The vocal responses were then analyzed for accuracy by the researcher. After the results were gathered, a group of three judges listened to 23 of the 93 responses and analyzed them in the exact same manner as the researcher. See Appendix D for the forms used for both of these analyses. A Pearson Correlation Test comparing the judges’ data to that of the researcher produced a high average correlation of 0.90.
CHAPTER 4

RESULTS

This study had one primary purpose: to determine the effects of gender and age on vocal modeling and the pitch-matching accuracy of young children. Within the development of the research, several subsidiary goals were also realized: to determine the effects of text versus neutral syllable approaches on the pitch-matching accuracy of children; and to compare the overall singing accuracy of male versus female children.

The following results will mention Groups I, II, and III. Group I responded to a child male model, Group II responded to a child female model, and Group III responded to an adult female model. All of the results will include both neutral syllable and song section singing responses unless specifically noted.

By breaking down these responses into vocal patterns sung on neutral syllables and song sections sung on text, it is possible to analyze which specific intervals were sung most accurately by the participants. While the same intervallic patterns were used for both the neutral syllable singing and the textual song sections, the neutral syllable vocal patterns were presented out of order to provide a smaller chance of familiarity for the song. Therefore, the vocal pattern “do-re-mi-do,” or
“Are you sleeping,” will be designated as Pattern 1; “mi-fa-so,” or “brother John?” as Pattern 2; “so-la-so-fa-mi-do,” or “Morning bells are ringing,” as Pattern 3; and “do-so-do,” or “ding, ding, dong” as Pattern 4.

**Effect of Pattern Complexity and Verbal Approaches**

Overall, the most successful interval was pattern one, with 69% accuracy. Pattern four resulted in 59% accuracy, pattern two had 53%, and pattern three netted the least, with only 37% accuracy. In comparing neutral syllable versus text singing, the neutral syllable approach provided the most accurate results. The greatest difference was found in pattern four. Participants responded with 65% accuracy for the neutral syllable approach as opposed to the text approach, which garnered only 53% accuracy. The only pattern that exhibited more success with the text approach was pattern one. The difference was only two accurate responses, however, in favor of the text approach. Please see Figure 4.1 for a full analysis of the neutral syllable approach versus the text approach.
Figure 4.1: Effects of neutral syllable and text approaches on pattern accuracy.

A Wilcoxon Signed Ranks Test was performed on the data, and the neutral syllable effect was found to provide significantly more accurate results than the text approach.
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<tr>
<td>Z</td>
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<tr>
<td>Asymp. Sig (2-tailed)</td>
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Table 4.2: Wilcoxon Signed Ranks Test comparing text versus neutral syllable approach.

**Effect of Vocal Model**

When the individual groups were analyzed, the neutral syllable and text approaches had less conclusive results. Group II had 70% accuracy for pattern four with the neutral syllable approach and 39% accuracy with the text approach. In Group I, participants were more successful with the text approach on pattern four. They had 45% accuracy with it and 42% for the neutral syllable approach. Group III had similar results, except theirs were slightly in favor of the neutral syllables. Those singers responded with 70% accuracy for the neutral syllable approach and 63% accuracy for the text approach. Figure 4.3a and 4.3b provide a break-down of the neutral syllable and text approaches by group.
Figure 4.3a: Group accuracy on patterns with the neutral syllable approach; b: Group accuracy on individual patterns with the text approach.

A Kruskal-Wallis Test was performed on the data, and it was shown that the model made no significant difference in the response accuracy of the participants.
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Test Statistics

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a. Kruskal Wallis Test.
b. Grouping Variable: Vocal Model.

(TXTCOR: Number of accurate responses with text; LOOCOR: Number of accurate responses with neutral syllable.)

Table 4.4: Kruskal-Wallis Test showing statistical significance of the vocal models.

Effect of Gender

When the results are compared with gender variability, several interesting patterns present themselves. Foremost, the females were significantly more accurate than the males. They achieved 62% accuracy, while the males were only 43% accurate. These responses were generated from a population of 40 males and 53 females.

All of the individual vocal patterns were sung more accurately by the females. Pattern two had the largest difference, as the females were 64% more accurate than the males when singing it. Pattern four had the least difference, with the females singing 15% more accurately than the males.
Both gender groups were more successful with the neutral syllable approach. The females attained 65% accuracy with the neutral syllables and 58% with the text; and the males had 49% accuracy with the syllables and 41% with the text.

A Mann-Whitney Test was performed on the data, and it was shown that the females sang significantly more accurately than the males.

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Test Statistics\(^a\)

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2. Grouping Variable: Subject Gender.

(TXTCOR: Number of accurate responses with text; LOOCOR: Number of accurate responses with neutral syllable; SUBGEN: Subject Gender.)

Table 4.5: A Mann-Whitney Test showing statistical significance of the subjects’ gender.
CHAPTER 5

DISCUSSION

The above study may have an impact upon elementary general music teachers, choral directors, and music specialists. While it was determined that there was no significant difference among the vocal models, the details of the results establish that future testing in this area is needed. The results do show, however, that child females sang significantly more accurately than child males and that a neutral syllable approach provided significantly more accurate results than a text approach.

Effect of Vocal Model

Unlike Green’s research (1987), which showed that the gender and age of a vocal model had a significant effect on the vocal accuracy of young children, this study disclosed that all of the vocal models produced accurate results. Several factors may have influenced the effectiveness of the vocal models. First, the participants were drawn from an elementary school with a widely respected music program. More specifically, the elementary music teacher is comfortable presenting music through many different methodologies and is a trained singer. Her vocal background has allowed singing to become a heavily utilized feature of her musical curriculum.
Therefore, the participants were already comfortable with vocally responding on a regular basis to an adult female with a trained voice.

As the adult female model also has a trained singing voice, this may have affected the subjects’ ability to respond accurately to child vocal models. In addition, the quality of the adult female model’s voice may have had an impact on the participants’ responses. The voice is light, lyrical, and almost child-like in quality, and the model contains little to no vibrato. Had the voice contained darker or more dramatic qualities, or had there been a large amount of vibrato, the results may have leaned more favorably towards the child vocal models.

Both child models were pulled from a neighboring elementary school in order to lesson the effects of familiarity. Several participants, however, made comments during the testing procedure that they knew the child on the television screen. The researcher also sat in the room while participants responded to her as the adult female model. It is possible that the prior personal knowledge among all of the models and the participants may have affected the accuracy of the results. A future study could include models unknown to the participants.

Finally, randomization may have allowed for the better singers to be clumped within the adult vocal model’s group. Although every effort was made to evenly distribute each group by grade and gender, no participant was categorized by their previous musical or singing experience. As shown in previous research, a child’s musical aptitude can greatly affect their ability to sing accurately (Aitchison, R.E. and Phillips, K.H., 1997; Gault, 2000; and Guerrini, 2002). It may be beneficial to account for this variable when conducting similar experiments in the future.
Effect of Gender

Singing experience may also have played a major role in the vocal accuracy comparison of the females and males. As displayed in the results, the females sang with significantly more accuracy than the males. Previous research has mirrored these results (Goetze, 1989 and Guerrini, 2002). The accuracy significance in the above study was found within each individual group and overall.

Many factors may have played into the female participants’ better vocal accuracy, such as the natural tendency for a female child’s environment to offer more opportunities for singing experiences than a male child’s. Young girls often involve singing in their playground games, such as jump-rope and hand-clapping. Many of these “playground songs,” such as “Miss Mary Mack” or “The Bottletop Song,” include relatively difficult melodic intervals, syncopation, wide vocal ranges, and even part-singing.

Additionally, girls are more likely to be involved in school choirs than young boys, especially at higher grade levels. According to their elementary music teacher, a majority of the female participants are also involved in Girl Scouts, a group which frequently incorporates singing at its meetings. Although both gender groups have equal access to singing experiences at school, church, and summer camps, it appears that the girls are more likely to take advantage of this access.

A few outside factors may have affected the boy participants’ abilities to respond with vocal accuracy. First, two of the fifth grade boy participants had difficulty singing the patterns in the range presented, particularly pattern four. One of them requested, and received, permission to sing pattern four down the octave. It is
possible that their voices were already beginning to go through inevitable changes. While these specific participants were able to overcome the vocal difficulties and achieve accuracy, other male participants whose responses were labeled inaccurate may have been experiencing the same problems.

Two younger boys mentioned another issue that may have affected the overall vocal accuracy of the boy participants. A portion of the testing was administered during students’ recess times. As such, some participants were pulled during, or immediately following, their recess. These two specific participants both mentioned that their voices were hoarse from screaming outside on the playground. When looking back at their individual results, accuracy most definitely could have been affected. While both girls and boys tend to raise the volume of their voices at outside recess, perhaps boys are more prone to harsh screaming, which can subsequently have an adverse effect on their singing abilities.

**Effect of Pattern Complexity and Verbal Approaches**

In the above study, the vocal pitch-matching accuracy of both gender groups was greatly affected by the utilized verbal approach. Participants responded significantly more accurately when singing on the neutral syllable “loo” rather than using the text. This finding both supports and contradicts previous research. Gault (2000) and Levinowitz (1989) found that children sing relatively more accurately with a text approach. Contrastingly, Goetze (1989) asserted that children sing more accurately with the neutral syllable “loo” than with a text approach. These three studies were conducted with groups of younger children, most of whom were in
kindergarten and first grade. The age gap for the above study could explain why certain results were simulated and others were challenged.

Many of the younger participants had difficulty echoing the text. This caused pitch inaccuracy during the text approach even when the participant had accurately responded with the neutral syllable “lool” for the same intervallic pattern. The text approach had the greatest effect on pattern three, with the words “Morning bells are ringing.” Many participants were unable to even echo the correct words for this pattern, singing responses such as “Orry bells are ring” or “Morny belter ringy.” Even though these participants responded inaccurately with pitch, the majority of them did follow the melodic contour of the line. Flowers and Dunne-Sousa (1990) relayed similar findings in their research.

An internal factor related to the experiment construction may have also interfered with verbal approach results. The intervallic patterns in “Are You Sleeping Brother John?” are repeated as part of the nature of the song, such as “Are you sleeping, are you sleeping, Brother John, Brother John?” All participants were given and attempted to echo these repeats. For the neutral syllable portion of the experiment, the intervallic patterns were only modeled once on the pattern “lool,” such as “do-re-mi-do” or “mi-fa-so.” If the patterns had been repeated on “lool” as they were for the text, it is possible that the neutral syllable approach may have been even more effective.

Future Implications

The factors mentioned above may have had an impact on determining the effects of gender and age on vocal modeling and the pitch-matching accuracy of
young children. For future research, several recommendations have emerged. When selecting a participation group, it may be beneficial to find a pool of elementary students whose music teacher is not vocally trained. If the participants were not as familiar with a female adult vocal model, the differences within the child male and the child female models may have been more pronounced.

A female adult vocal model with less training may also provide different results. The adult model’s voice for this study could have caused the participants to respond with more accuracy because of her lightness in tone and quality, her ability to lessen the vibrato, and its general child-like characteristics. Finding an adult model whose voice is less child-like would be a possibility for future research.

In addition to the music environment for the participants, both the grade level and the gender distribution should also be reviewed. The natural voice development of children may have affected the accuracy of the research. Research has shown that a first grade student will normally have less vocal accuracy success than one in the third grade (Goetze, 1989). As the grade gap for this study spanned from first to fifth grade, it is possible to conjecture that the upper elementary students were singing with more accuracy than the lower elementary students. Developing a future study with participants in the same grade level might be advantageous.

Along with a grade level gap, there were also more females than males in the participant group. Several previous studies have shown that females generally sing more accurately than males (Goetze, 1989 and Guerrini, 2002). While this study mirrored those results, an even female to male distribution could have definitely strengthened the research and data analysis.
This study has given many opportunities for the advancement of research in children’s vocal pitch-matching accuracy. It questions whether young children respond better to vocal models of their gender and age. It also confirms that female children usually sing more accurately than male children. The results project that both genders of children are prone to sing more accurately with a neutral syllable approach rather than a text approach. With fine-tuning, similar future studies could continue to contribute to improved vocal methods and children’s singing accuracy.
APPENDIX A
Research, Involving Human Subjects

ACTION OF THE INSTITUTIONAL REVIEW BOARD

Full Committee Review  X  Expedited Review
X  Original Review  X  Continuing Review

With regard to the employment of human subjects in the proposed research protocol


the Behavioral and Social Sciences IRB has taken the following action.

_ APPROVED _ APPROVED WITH CONDITIONS _ WAIVER OF WRITTEN CONSENT GRANTED _ DISAPPROVED

- **Conditions**: Due to the IRB not being met by the investigator, therefore, the protocol is APPROVED.
- **Waiver of Written Consent**: GRANTED

- No further modifications may be made without prior review and approval from the IRB.
- You are required to report any problems to the IRB.
- You are also required to report the identity of the research participants in the log to the principal investigator.
- It is the responsibility of the principal investigator to maintain a copy of each signed consent form for at least three (3) years beyond the termination of the subject's participation in the proposed activity. Should the principal investigator leave the University, signed consent forms must be transferred to the Human Subjects IRB for the required retention period.

Date: April 11, 2014
Sign off: [Signature]

[Stamp: OHIO STATE UNIVERSITY]

[Stamp: Office of Responsible Research Practice]
APPENDIX B
April, 2004

Dear Parents/Guardians,

In the spring of 2001, I was honored to student-teach with Mrs. Claudia Jones. Beginning in April of 2004, as a part of my continuing studies at The Ohio State University, I would like to measure the effects of gender and age on the singing responses of students at Britton Elementary School. The data and responses collected from this research would be used in my master’s thesis. No specific student name will be mentioned and all data will be reported anonymously.

If you agree to your child’s participation, please sign the form below and return it to Mrs. Jones within the next week. I truly appreciate your support in this endeavor. Thank you very much.

Sincerely,

Amy G. Pluth
Graduate Teaching Associate
The Ohio State University

_____ I agree to my child’s participation.

_____ I do not agree to my child’s participation.

Student name ___________________________ Class

________________

Parent/Guardian Signature_________________________ Date__________
April, 2004

Dear Parents/Guardians,

Thank you very much for your response to my earlier letter allowing your child’s responses to be included in my master’s thesis through The Ohio State University. The project will commence in April of 2004.

For this study, student’s responses will be audio taped and listened to by a panel of experienced music educators. Once again, all students’ names and identities will be left out of this study. The data collected will be kept completely anonymous. Including me, the three people who will be involved in the recording process are all licensed music educators in the state of Ohio. The recording process will take approximately four to five minutes per student.

I need your written permission for your child to be audio taped in the Britton Elementary School music classroom. Please sign below and return this letter to Mrs. Claudia Jones as soon as possible.

Again, I truly appreciate your support. Thank you very much.

Sincerely,

Amy G. Pluth
Graduate Teaching Associate
The Ohio State University

_____ You have my permission to audio tape my child’s vocal responses and include the data in this study.

_____ Please do not audio tape my child’s vocal responses for this study.

Student name________________________________________
Class_____________________

Parent/Guardian Signature_____________________________________
Date__________
February, 2004

To Whom it May Concern:

In January of 2004, Amy Pluth approached me about conducting a musical study involving the students of Britton Elementary School. She explained that she is interested in judging the effects of gender and age upon the vocal modeling responses of young children. In order to verify the accuracy of their singing, their responses will be audio taped and presented to a panel of experienced music educators. No names will be identified, and the data collected will be kept anonymous. Amy will be conducting her research with Dr. David Frego and she will be assisted by the Britton Elementary School music teacher, Mrs. Claudia Jones.

I realize that this research is essential to the completion of a master’s thesis for Mrs. Pluth. She has my full consent to proceed with this study.

Sincerely,

Pat Farrenkopf  
Principal, Britton Elementary School  
Hilliard, Ohio
April, 2004

To Whom it May Concern:

In April of 2004, Amy Pluth approached me about conducting a musical study involving the students of Britton Elementary School. She explained that she is interested in judging the effects of gender and age upon the vocal modeling responses of young children. In order to verify the accuracy of their singing, their responses will be audio taped and presented to a panel of experienced music educators. She has asked that I participate in her study as a member of this panel, and I have graciously accepted this responsibility.

I realize that this research is essential to the completion of a master’s thesis for Mrs. Pluth.

Sincerely,

__________________________
(printed name)

__________________________
(signature)
May, 2004

Dear Parents/Guardians,

In the spring of 2001, I was honored to student-teach with Mrs. Claudia Jones at Britton Elementary School. Beginning in May of 2004, as a part of my continuing studies at The Ohio State University, I would like to measure the effects of gender and age on the singing responses of students at Britton Elementary School. Dr. David Frego, the Assistant Director at The Ohio State University School of Music, will be advising this research.

For this study, it is important that the vocal models not be in constant interaction with the other children. Hence, I have asked Mrs. Wenner to recommend two vocal models from Norwich Elementary School. Your child has been suggested as one of these vocal models. He/she would be videotaped singing a familiar song (“Are You Sleeping, Brother John?”) and a group of vocal patterns. Although Britton Elementary School students with parental consent will watch and echo this singing, your child’s name will not be used. In addition, their identity will be kept completely anonymous and left out of the research. The people who will be involved in the recording process are all licensed music educators in the state of Ohio.

If you agree to your child’s participation, please sign the form below and return it to Mrs. Wenner within the next week. I truly appreciate your support in this endeavor. Thank you very much.

Sincerely,

Amy G. Pluth
Graduate Teaching Associate
The Ohio State University
University School of Music
(614) 336-0175

Dr. David Frego
Assistant Director
The Ohio State School of Music
(614) 292-2870

_____ I agree to my child’s participation. You have my permission to videotape my child as a vocal model for this study.

_____ I do not agree to my child’s participation. Please do not videotape my child as a vocal model for this study.

Parent/Guardian Signature____________________________
Date______________
APPENDIX C
The following is an example script for the experiment:

Co-Researcher:

“Good morning/afternoon. You’re going to be doing a bit of listening, watching, and singing today. You may sit or stand – whichever makes you feel the most comfortable. Please remember that you’re going to be singing, though, and that means you need to have good posture!

On this television, you will see and hear a girl/boy/adult sing several patterns on the word ‘loo.’ I would like you to sing or echo each pattern exactly as you hear it. Once these patterns are sung, the singer on the T.V. will perform a song that you might know. Please listen as they sing it. Finally, they will split that song up into small parts, which you will echo like the patterns. Do you have any questions?”

Participant: (example questions)

“Which TV will be used?” “Do I have to sing loud?” “Do I have to stand?” “Do I need to use the headphones?” “Do I have to sing into a microphone?”

Co-Researcher: (once all questions had been answered)

“If you remember, the first thing you will see and hear is a girl/boy/adult singing patterns on the word “loo.” Please sing or echo these patterns exactly as you hear them.”

Co-Researcher: (once the vocal patterns had been sung, immediately before the song)

“Now you will hear the girl/boy/adult singing a song. Please just listen.”

Co-Researcher: (once the song had been sang)
“Now the girl/boy/adult will break the song you just heard into small parts or chunks. Please sing or echo these patterns exactly as you hear them.”
APPENDIX D
ACCURACY REVIEW FORM

As you listen to each audiotaped response, you will first hear a vocal model sing pitched patterns on a neutral syllable. The model will call and the child will echo. After the vocal patterns are sung, the vocal model will present the song “Are You Sleeping?” in its entirety. Then, the model will once again call with small phrases of the song (which the child will echo).

Please individually mark the child’s ability to echo-sing the vocal patterns and the sections of the song “Are You Sleeping?” with a check-mark for accuracy or a blank-mark for inaccuracy. If the child sings none of the vocal patterns or song sections accurately, please put a check-mark in the “O” column.

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LIST OF REFERENCES


