THE EFFECT OF SIGHT-SINGING ON SIGHT-READING IN THE HIGH SCHOOL STRING CLASSROOM

by

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(Under the Direction of Mary Leglar)

ABSTRACT

The purpose of this study was to determine the effect of structured vocal sight-singing instruction on instrumental sight-reading performance and to determine the validity of the Alexander and Henry Pitch-Skill Hierarchy (2012). Using a pretest-posttest design, four research questions were addressed: (1) Did structured instruction in sight- singing significantly improve instrumental sight-reading? (2) Is the Alexander and Henry Pitch-Skill Hierarchy (2012) valid for high school string players of varying instrumental sight-reading ability? (3) Did the performance of high school string players of varied ability, after receiving structured instruction in sight-singing, validate the Pitch-Skill Hierarchy established by Alexander and Henry (2012)? (4) Do factors beyond the control of the experiment, such as gender, age, grade level, private lessons, theory instruction, and previous instruction in singing, have any influence on the students' instrumental sight-reading ability?

Thirty-one North Georgia high school students participated in the study. The participants were volunteers registered for a bi-weekly extension period in addition to a daily orchestra class. The students were divided into two statistically equal groups based on a pretest. The control group received instrumental sight-reading instruction only. The experimental group received vocal sight-singing instruction on solfege along with instrumental instruction. Both groups performed a posttest after the eight-week treatment period.

The pre- and posttest used were the Alexander and Henry Sight-Reading Test (2012). Students were graded for accuracy on 31 pitch-skills comprised of eight categories. The results indicated that although the experimental group performed better than the control group, the difference was not significant. Pretest score, age, instrument, and key signature all had a significant effect on the results of the posttest.

Using the same method as the Alexander and Henry study, the difficulty level of pitch-skill categories was assessed to validate the Pitch-Skill Hierarchy. The pretests of all the students and the posttests of the two groups each ranked the pitch-skill categories in a different order than the original hierarchy. These results proved the Alexander and Henry Pitch-Skill Hierarchy invalid for students of differing abilities. In conclusion, the research indicates that vocal sight-singing instruction has a positive impact on instrumental sight-reading.

INDEX WORDS: Sight-singing, sight-reading, orchestra, pitch-skill, high school, education

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CHAPTER 1

INTRODUCTION AND OVERVIEW

> To teach a child an instrument without first giving him preparatory training and without developing singing, reading and dictating to the highest level along with the playing is to build upon sand. –Zoltan Kodaly, 1974 (p.193)

In theory, few people would dispute the wisdom of Kodaly's words; in practice, however, singing is often included incidentally or totally ignored in America's instrumental classrooms. Typically, band and orchestra rehearsals are focused solely on gaining instrumental technique and preparing repertoire for mandatory performances and upcoming concerts. According to Mitchell Robinson (1966), conductors often do not include singing in the rehearsal because they are trying to save time, are reluctant to model vocal sound, or anticipate negative student reaction.

Although research has addressed some of these objections and the benefits of singing in the instrumental classroom have also been articulated, the neglect of singing largely persists. Studies conducted by McGarry (1967) and Dunlap (1989) found that taking time to sing in rehearsal did not detract from success in instrumental performance. Rowher (1995) emphasizes that singing allows instrumentalists to focus on the sound first, and then on reproducing it on their instruments. In this way "the psychomotor limitations of the young instrumentalist can be factored out while basic musical development is improved" (p. 75). Chosky (2001) further notes, "Musical knowledge acquired through singing is internalized in a way that musical knowledge acquired through an instrument—an external appendage—can never be" (p. 82).

Many string pedagogues and string methods book also recommend the use of singing in the classroom to build the students' concept of pitch. Michael Hopkins (2012) strongly endorses singing in the string classroom to reinforce aural development and intonation. Colleen Conway (2003) points out, "If singing in tune is important to tonal success, then the singing of songs should be an important activity in early instrumental lessons" (p. 29). Intonation on a string instrument is highly dependent on the ear of the player because there are no keys, buttons, or frets to determine pitch. Student must rely on their ear and muscle memory to play with correct intonation.

Need for the Study

Despite the widely held belief that singing is beneficial in the string classroom, there is little research to support it. A review of the literature produced only two studies that specifically tested the effectiveness of singing in the string classroom. Dell (2003) and Frank (2006) both found singing to be an effective technique, but both studies were focused solely on the intonation ability of beginning string players in the elementary school. Although a few researchers, such as those cited above, have been interested in singing and instrumental intonation, no studies were found that specifically investigated the effect of sight-singing on the instrumental sight-reading ability of high school string students.

Research on string sight-reading is limited largely to the recent work of Michael Alexander and Michele Henry (2012), who developed the Pitch-Skill Hierarchy for strings. The hierarchy analyzes the elements of pitch in string sight-reading and ranks them from easiest to most difficult, providing an excellent basis for evaluating sight-reading skills. While the hierarchy is beneficial for examining which elements of sight-reading are more complex for students, it was conducted using only advanced high school players. Further, the Alexander and Henry study did not examine the efficacy of structured methods of teaching sight-reading, but only how well pitch skills were performed.

Purpose of the Study

The present study addressed the effectiveness of sight-singing as a method for teaching instrumental sight-reading in the high school string classroom. The purpose of the study was threefold:

1. To determine whether structured sight-singing significantly improves instrumental sight-reading proficiency.
2. To determine whether the Pitch-Skill Hierarchy (Alexander & Henry, 2012) is valid for high school string players of varying sight-reading ability.
3. To determine whether structured sight-singing instruction in the string rehearsal affects the validity of the Pitch-Skill Hierarchy (Alexander & Henry , 2012).

Research Questions

The research questions of the study were:

1. Did structured instruction in sight-singing significantly improve instrumental sight-reading?
2. Is the Alexander and Henry Pitch-Skill Hierarchy (2012) valid for high school string players of varying instrumental sight-reading ability?
3. Did the performance of high school string players of varied ability, after receiving structured instruction in sight-singing, validate the Pitch-Skill Hierarchy established by Alexander and Henry (2012)?

4. Do factors beyond the control of the experiment, such as gender, age, grade level, private lessons, theory instruction, and previous instruction in singing, have any influence on the students' instrumental sight-reading ability?

Methodology

Subjects for the study were 31 ninth- through twelfth-grade orchestra students attending a suburban high school in northwest Georgia. The students, enrolled in three different levels of orchestra that met daily, also enrolled in a bi-weekly voluntary enrichment period during the school day. The period provided 40 minutes of extra practice time, chamber music, and other extension orchestra activities beyond the typical classroom rehearsal. All students who chose to participate returned a parental consent form. No student was required to participate in the study.

The study employed a pretest-posttest design. The pretest utilized an Alexander and Henry sight-reading example made up of six eight-measure melodies (see Appendix C). Students were given 30 seconds to review each melody before recording it. To provide anonymity, each student was be assigned a number for scoring purposes. The researcher and two other experienced orchestra teachers scored the pretests according to the Alexander and Henry scoring procedure, validated in their original study. Following the pretest, students were ranked according to their grade. Students were then divided into a control and experimental group using the following method. Beginning with the highest score, students were grouped into pairs of two. For each pair, a coin was flipped for the first person. When the coin landed on "heads," that student was assigned to the control group. When the coin landed on "tails," that student was assigned to the experimental group. The second student of the pair was assigned to the other group. This method continued for the entire list to assure that students were randomly assigned to create two groups of relatively equal ability. The researcher taught both groups. Information regarding grade level, involvement in private lessons, and additional theory and singing instruction was provided obtained via a student questionnaire.

During the eight-week treatment period, each group received 15 minutes of sight-reading instruction twice a week. Musical examples were drawn from Dabcyznski, Meyer, and Phillips' *Sight-Read It for Strings* (2006) as well as researcher-generated material. Both groups were prepared by noting tempo, key and time signatures, accidentals, and "road map" before performing sight-reading examples that specifically focused on the elements of the Pitch-Skill Hierarchy. In addition, the experimental group was taught movable do solfege. Before playing each example the experimental group sang the example by sight using movable do solfege.

Following the same procedure used in the pretest, a posttest was administered to all students after the eight-week period. To address the first research question, the posttest scores of the control and experimental groups were compared using a *t* test. The second research question was addressed by comparing the results of the pretest for each specific pitch-skill to the Alexander and Henry's (2012) results. The third research question was addressed by comparing the results of the posttest for the experimental group only to the results of the Alexander and Henry study. The final research question was addressed using a general linear model (GLM) and the results of the questionnaire.

Delimitations of the Study

This study was delimited to string classes of a suburban high school in North Georgia, representing varying ability levels and ranging from four to seven years of instrumental study. The focus of the scoring was delimited to pitch. Rhythm, although important in sight-reading, is less relevant to the application of solfege and therefore was not stressed during the treatment period. Sight-reading examples were delimited to major keys because of the brief duration of the study.

Definition of Terms

Instrumental sight-reading: Instrumental performance of music that the performer has not previously seen or studied.

Moveable do solfege: The assignment of syllables “do,” “re,” “mi,” “fa,” “sol,” “la,” and “ti” to pitches of the scale. As in the Kodaly method, “do” stipulates the tonic of the major key.

Pitch skill: A tonal pattern commonly found in major keys. It can be ascending or descending step-wise motion, a skip or leap within a chord, or a cadential, modulatory, or chromatic pattern. Pitch skills will be identified by their solfege abbreviation.

Pitch-Skill Hierarchy: As set forth in Alexander and Henry’s 2012 study, it is the ranking of pitch-skills from easiest to most difficult. See Table 2.

Structured sight-singing methods: Teaching techniques that utilize vocal sight-singing and movable do solfege to prepare students for instrumental sight-reading.

Organization of the Study

The study is organized as follows.

Chapter 1: INTRODUCTION AND OVERVIEW

Chapter 2: RELATED LITERATURE

Chapter 3: METHODOLOGY

Chapter 4: FINDINGS

Chapter 5: SUMMARY, DISCUSSION, and CONCLUSIONS

CHAPTER 2

RELATED LITERATURE

Research concerning singing in the high school orchestra classroom is very limited. No parallel studies concerning improving sight-reading in the string classroom were found. Research pertinent to certain aspects of this study falls into three categories: (1) singing to improve the instrumental performance of beginning band classrooms; (2) aural approaches to sight-reading on instruments; and (3) string-specific studies. All studies will be presented in chronological order of their publishing.

Singing to Improve Instrumental Performance in Beginning Band Classrooms

Robert McGarry (1967) conducted the earliest study examining the effectiveness of singing in the instrumental classroom. McGarry used junior high band students to determine the effectiveness of vocalization in improving instrumental performance skills. Seventy-four junior high school students were randomly assigned to control and experimental groups based on initial performance on Form A of the *Watkins-Farnum Performance Scale (WFPS)*. Each group received homogeneous instrument lessons for 14 weeks for 18 minutes. Lesson material was derived from Form B of the *WFPS.* Both groups covered the same instructional material, but the experimental group used vocalization for letter names, rhythm patterns, and articulation patterns. The experimental group also devoted two minutes of each class to singing the exercise on a neutral syllable with a recorded or live performance of the exercise before playing the exercise. A posttest was given using Form A of the *WFPS.*

McGarry's results showed that the experimental group scored higher than the control group in instrumental performance, but the difference was not significant. Only the lowest quartile of the experimental group made significant gains compared to the similar quartile in the control group. McGarry therefore concluded that vocalization is an effective technique for instrumentalists with below average performance ability, despite the small size of the lowest quartile (nine students). Further, McGarry's approach differs from that of the present study in that all of the students sang with a recording or live performance of a piece and were not expected to generate vocal pitch on their own accord. Nonetheless, McGarry's results do suggest that vocalization in the band classroom can be as helpful as instruction that focuses solely on the instrument and that the time spent vocalizing does not necessarily impede progress.

Charles Elliott conducted a 1972 study using vocalization with beginning band classes. Elliott's purpose was to discover what effect the regular use of vocalization had on the students' sense of pitch. Elliott used six beginning band classes at six different public schools, with three schools assigned to be the experimental groups and three schools assigned to be the control group. All schools used the same method book and met once a day in a heterogeneous setting. Each student was given a pretest using the pitch discrimination and tonal memory sections of the Seashore *Measures of Musical Talents*. All groups scored similarly in the pretest.

For the treatment, the directors of the control groups were told to conduct their groups as they usually do. The instructors of the experimental groups were told to have students vocalize designated pitches and exercises on a neutral syllable, "la." The treatment lasted the entire school year with students given a posttest during the final week of school. The posttest again used the pitch discrimination and tonal memory sections of the Seashore *Measures of Musical Talents* and also included a researcher-constructed test to measure the student's ability to match music perceived aurally with musical notation and the *Kwalwasser-Ruch Test of Musical Accomplishment,* which measures the mental ability to audiate notated music.

Results indicated that all groups showed improvement from pretest to posttest scores. On all three posttests, however, the experimental groups scored significantly higher than the control groups. Elliott also found that vocalization in the band classroom compensated for previous participation in private piano lessons.

LaPointe Davis conducted a study in 1981 that looked at the effectiveness of singing activities on elementary band students' performance as well as their self-evaluation skills and attitude toward music. Davis studied 59 fifth- and 34 sixth-grade students at three different Ohio elementary schools. The fifth-grade students were in their first year of performance on a band instrument, and the sixth-grade students were in their second year. Davis created three experimental groups for each grade, as well as three fifth-grade control groups and two sixth-grade control groups. Outside instructors taught three of the control groups, and Davis taught all remaining classes. One experimental group in each grade received structured singing activities as part of their band class, one experimental group in each grade received instruction in self-evaluation practices, and one experimental group received both singing and self-evaluation practices. The control groups received none of the special instruction methods. The singing groups used numbers and neutral syllables to sing tunes and etudes before playing them on their instrument. The self-evaluation groups periodically recorded their in-class performances and gave critical responses to their playback with the instruction of the researcher.

Davis looked for differing outcomes in instrumental performance, achievements in tonal imagery, and student attitudes. Some of the experimental groups showed significant improvement in performance over the control groups; the most effective group was the one that received combined singing and self-evaluation practice. The fifth-grade singing group fared better than the sixth-grade singing group when compared to their peers. It was concluded by the researcher after the study, however, that the initial level and experience of the various groups was not equal and it was therefore difficult to compare the groups.

Michael Dunlap extended Davis' work in a 1989 study that looked specifically at the use of solmization in the beginning band classroom. Dunlap focused on whether singing and solmization in the instrumental classroom would lead to greater vocal accuracy, melodic ear-to-hand coordination, melodic aural-visual discrimination, instrumental performance, and instrumental sight-reading skills. Ninety-two beginning fifth-grade band students from four elementary schools in the same Michigan school district were used. The same teacher taught all classes. Intact heterogeneous beginning band classes were used, with two of the schools serving as control groups and two serving as experimental groups. Instruction in all groups was identical with the inclusion of singing and solmization activities in the experimental groups. Following the fourteen-week study, all students were tested with Stauffer's *Melodic Echo Test*, the *Melodic Ear-to-Hand Coordination Test* and *Test of Melodic Reading Recognition* designed by James Froseth, and the *Instrumental Performance Test* and *Instrumental Sight-Reading Test* designed by the researcher.

After the results were adjusted to compensate for prior experience and non-random groupings, no significant differences were found among the groups. The solmization and singing training did not help or hurt the instrumental performance of the experimental groups. There was a positive correlation between vocal accuracy and the other measurements of the experimental group that suggested the vocal training was effective but would need a longer period of treatment to show more effect. As in McGarry's 1967 study, results indicated that the vocal training did not impede instrumental ability, even though it reduced time spent on the instrument itself. Dunlap suggests that the same vocal activities with more experienced players might have a greater effect because the players are already more confident on the mechanics of their instrument and can make subtler adjustments to their performance.

In summary, all of the above studies concluded that singing in the beginning band classroom seemed to be an effective teaching tool. No study found that the inclusion of singing weakened the students' instrumental performance. It is interesting to note that all of these studies were done with beginning band students, when instruction typically focuses on the development of technical skills on the instrument.

Aural Approaches to Sight-Reading on Instruments

The previous category of studies looked at the effect of vocalization on instrument performance. This next category will examine studies that focused solely on instrumental sight-reading, investigating the use of vocalization or aural training to enhance instrumental sight-reading skills.

One of the first studies to examine how sight-reading relates to ear training was by John Luce in 1965. Luce examined the relationship between a high school instrumentalist's ability to sight-read music and to reproduce music by ear. Luce also examined what student characteristics—length of music instruction, intelligence quotient, mental age, leadership status, music goals—contributed to the students' performance ability. Luce tested 98 high school students in Lincoln, Nebraska. The students ranged from ninth to eleventh grade and represented both band and orchestra players. The students were given a sight-reading test consisting of eight eight-measure examples. The ear-playing test was six two-measure examples played three times before the students were asked to reproduce it.

Results found that there was a significant correlation between sight-reading and ear-playing. Intelligence quotients and mental ages also had a high relationship to sight-reading and ear-playing ability. Luce recommended that ear-playing be included in the instrumental curriculum in addition to instruction in sight-reading. An interesting note from this study is that 37 of the students succeeded at more complex levels of sight-reading after failing easier levels. Luce recommends examining the levels of complexity in sight-reading, an issue that was subsequently tackled by MacKnight (1975), Grutzmacher (1987), and Alexander and Henry (2012).

Carol MacKnight's 1975 study focused again on beginning wind instrumentalists but taught music reading through the use of tonal patterns and specifically used singing and aural presentation. MacKnight's subjects were 85 fourth-graders at three different elementary schools in Bay Shore, New York. A different instructor taught at each school, but each had previously worked with the investigator in a six-week pilot study to familiarize themselves with the teaching methods and procedure. One school was randomly assigned to be the experimental group, and the other two schools served as control groups. Classes were homogeneous and had weekly 30-minute lessons for 32 weeks. All classes covered the same material but the experimental group was introduced to pitches as a series of patterns and the control group was presented with new pitches one at a time. In the experimental group, melodic patterns were taught first through aural presentation, then as an auditory-visual presentation, and finally as an auditory-visual presentation within a musical phrase. Students in the experimental group responded both vocally and instrumentally.

The results showed statistical significance favoring the experimental group that approached music notation through tonal patterns. Students in the experimental group with a low musical aptitude particularly showed greater improvement over their control group peers in sight-reading. MacKnight concluded that singing with tonal syllables may lead to a higher level of musical understanding and that reading materials that introduce notes and rhythms in frequently occurring patterns is beneficial to sight-reading pedagogy.

Although not the next study chronologically, Patricia Grutzmacher's 1987 study was a follow-up to MacKnight's. Grutzmacher also presented notes as a series of melodic patterns and studied the method's effect on sight-reading. Subjects were 48 first-year instrumental students in fifth- and sixth-grade band in three Ohio public schools. Students were randomly assigned to homogeneous instrument classes, and a control and experimental group were randomly assigned to each school. The researcher taught all classes. The experimental group focused on isolated melodic patterns and over the course of the fourteen-week period examined 20 major and minor tonal patterns. The patterns were presented aurally and then through notation. The students harmonized and vocalized with each pattern as well as performed them on their instruments. The control group did not use these melodic patterns, nor did they vocalize or perform with harmonization; new material was presented through fingerings and notation.

Pretest and posttest results from the *Iowa Tests of Music Literacy,* as well as researcher-constructed tests that utilized the 20 major and minor tonal patterns, were compared. There was a significant improvement in melodic sight-reading for the experimental group over the control group. Much like MacKnight, Grutzmacher recommends the use of tonal patterns and vocalization to teach note reading and sight-reading.

While many studies focused on beginning instrumental students, Bozone (1986) and Sheldon (1998) looked at college-aged students. Bozone used two second-semester piano classes at the University of Oklahoma, comprising a total of 17 students. Students were randomly assigned to the two classes. One served as the control group and one as the experimental group. Both classes were made of students who had just completed an identical first semester of piano class so their entrance levels were equal. The two classes met three times a week for one semester and spent 12 minutes of each session on sight-reading. The researcher taught both classes, with the only difference being the addition of sight-singing in the experimental group. The experimental group used "la" to sing the melody line before performing it on piano. At the end of the semester, both groups were tested on their sight-reading with attention to pitch, rhythm, and expression. The experimental group tested significantly higher than the control group in all areas, especially in expression accuracy. Bozone strongly recommends the use of sight-singing in piano sight-reading. Bozone's study most closely resembles the present investigation in its use of pretest-posttest control group design.

Deborah Sheldon (1998) also examined the effect of sight-singing methods with college-aged students. Sheldon focused specifically on whether training in sight-singing would improve instrumental music education students' error detection skills in the context of a band rehearsal. The study used 30 students from a large midwestern university. All students had the same collegiate-level training in conducting and rehearsal techniques and were split randomly between an experimental and a control group. The control group received regular instrumental methods training over the course of the 16-week semester. The experimental group had the same instrumental methods instruction but also received 11 weeks of instruction in aural training and contextual sight-singing using solfege.

Students were given a pre- and posttest on identifying pitch and rhythm errors in musical excerpts. The repertoire was chosen to replicate what the students might see in a school band classroom. The two groups performed comparably on the pretest, but the experimental group showed significant gains over the control group in the posttest. In both groups, rhythm errors were identified more accurately than pitch errors. This was particularly remarkable for the experimental group, which had focused on pitch in the sight-singing training. Sheldon attributed this to the fact that the treatment period was relatively short and speculates that, with increased sight-singing training, pitch error identification would improve. Sheldon concluded that sight-singing is an effective tool for instrumentalists.

Haston (2004) compared the effectiveness of sight-reading training using an aural/modeling emphasis with a traditional notational emphasis with beginning wind players. Participants, 20 fourth-grade beginning band students from three Virginia elementary schools, signed up for the class time that worked best for their schedule, unaware of which was the experimental and control group. The groups were evaluated using the *Gordon Musical Aptitude Profile* and portions of the *Tonal Imagery* test and *Musical Sensitivity* test to evaluate previous musical knowledge and compensate for nonrandom group assignment. The same instructor taught both classes, with the difference being the method of instruction. All skills, from breathing and posture to hand position, were explained to control group students without the use of modeling. Sound was not modeled on the instrument, and there was no singing or playing by ear. For the experimental group, the researcher demonstrated skills and modeled sound, and songs were learned by ear before they were seen in notation.

A posttest was given using a prepared piece and sight-reading from the *WFPS*. The results did not show a significant difference between the two groups. An unusual finding, however, was that the students in the aural/modeling group with no prior musical training outperformed the aural/modeling group students with prior musical training. The opposite was true for the visual group. There were no data to explain this, but Haston surmised that either the previous musical training received by the aural/modeling group did not include sight-reading or that the students with no prior training were better able to rely on the sound produced and not the visual aspect of sight-reading. Just as Dunlap (1989) concluded that singing in the instrumental classroom did not detract from the students' ability to perform on their instrument, Haston points out that the aural/modeling emphasis did not lessen the group's ability to sight-read music notation.

String-Specific Studies

The previous studies were all done with piano or band students. There is significantly less research on the topics of singing in the string classroom and the development of string sight-reading technique.

Dell (2003) examined the effect of singing and tonal pattern instruction on the intonation of beginning string students. One hundred and fifty-eight first- and second-year students in the fifth and sixth grades from two suburban South Carolina school districts volunteered. They comprised nine intact classes of heterogeneous string instrumentation. All students were assessed for prior musical and singing experience before the treatment. The classes were divided into three groups—two experimental and one control group. The independent variable was the type of instruction delivered over the one-year period. One experimental group had an aural-based treatment and the other had aural-based treatment with tonal pattern enhancement. The aural-based methodology introduced new concepts aurally with students singing melodic and bass lines. For the second experimental group, concepts were introduced aurally and the Gordon *Jump Right In* tonal patterns series were also used within the lessons. The control group's instruction was purely notation-based. Dell had conducted a preliminary study to perfect the tests used over the yearlong treatment. Although different teachers delivered instruction, all were trained by the researcher in the various methodologies, and all met bi-monthly to discuss the project and make sure the different classes were moving at the same pace.

The study was a posttest-only design. The dependent variable measured was the Intonation Performance Composite (IPC), a combination of the students' performance on the *Pitch Matching Index* (*PMI*) and *Intonation Performance Index* (*IPI*). The *PMI* was a measure of how well the students matched pitch on their instrument to a recording of a pitch. The *IPI* measured intonation accuracy on the students' performance of two eight-measure etudes created by the researcher.

The results showed that the aural-based training had a significant effect on intonation performance and was more effective than notation-based training. There was no significant difference between the aural-based and aural-based with tonal pattern enhancement groups showing that the pattern training did not have as great an effect as the aural approach. Both aural-based groups used solfege and singing in the classroom, and that proved to be the greatest influence on the students. Dell concluded that the tonal pattern focus did not detract from the student's learning and was not an ineffective technique; it just was not significantly more effective than the aural-based training alone. Dell's conclusion concurred with the research done on wind and brass instruments by McGarry (1967) and Elliott (1974): an aural approach to learning to play an instrument, specifically with singing in the classroom, leads to better intonation.

A 2006 study by Heather Frank furthered the work of Dell by examining the relationship of singing intonation with playing intonation in beginning string instrumentalists. Frank tested 31 beginning violin and viola students from a public elementary school in East Lansing, Michigan. The students were fifth and sixth graders in either their first or second year of playing. Students were tested in two phases. The first phase was to familiarize the students with the testing environment and also serve as a pilot test to create a rating scale for the judges who would evaluate the second phase. In the first phase, the students were individually recorded singing *Row, Row, Row Your Boat*. Each student was given a chord progression on a piano to establish the key and then the researcher sang the starting pitch. The data gathered from this phase were not used in the final correlation.

To prepare for the second phase, the researcher taught the students how to play *Yankee Doodle* in G Major on their instruments. The researcher used traditional notation and notation utilizing note names as the students were accustomed to using in their regular orchestra class. The researcher specifically wanted the students to perform an already-learned tune so that the focus could be on intonation and not on sight-reading ability.

In the second phase, the researcher recorded the students playing *Yankee Doodle* as they were taught in class. Students were allowed to use notation and did not have to play from memory. They were all instructed to use the same fingering, including open strings, to maintain consistency between all subjects. Each student played the tune twice to become more comfortable in the environment, and only the second recording was used for scoring. Along with performing the song on their instrument, students also sang *Yankee Doodle* in E-flat Major, a key more comfortable for their voices than G Major. Students were given a chord progression in the key and then their starting pitch sung by the researcher.

Six different judges evaluated the recordings from phase two using the rating system developed after phase one. Scores were given from one to five, with one being never in tune and five being perfectly in tune. The vocal and string playing scores were compared using the Pearson product-moment correlation. The correlation coefficient was 0.41, a moderate strength correlation that was significant and suggested a relationship between singing and playing intonation.

Both previous string studies looked at the effect of singing as compared to intonation for strings. Michael Alexander and Michele Henry (2012) conducted a study to examine string sight-reading and develop a pitch-skill hierarchy to influence string pedagogy. They also examined whether key has an effect on string sight-reading and if a tonal pattern system should be used to evaluate melodic sight-reading on string instruments. Although the focus of the study was not to examine the effects of a specific methodology on string sight-reading, Alexander and Henry were able to draw conclusions about sight-reading from the hierarchy they developed.

Alexander and Henry adapted the *Vocal Sight-Reading Inventory* (*VSRI*), developed by Henry for use in the vocal classroom, to be applicable to strings. The *VSRI* analyzes tonal relationships between pitches, identifying them using solfege syllables so they can be applied to any key. There were 31 pitch-skill combinations that included all step and leap combinations within an octave. The combinations were then written into six- to eight-measure melodies of increasing difficulty. Simple rhythmic values were used so that the focus could remain on the pitches. Each melody was written in D, E-flat, and E Major to include an open-string key, a flat key, and a sharp key. Three test versions were created with six melodies each. All three test versions used two examples in each key.

The test was then given to 94 high school string students at a weeklong summer music camp. Due to the nature of the camp, many of the players were highly experienced and had been accepted into various state and region honor orchestras. A survey was given to the students to determine the number of years they had played their instrument, number of years of piano instruction, and sight-reading experience. Students were given 30 seconds to study each example before they played it for a recording.

The recordings were scored in two ways. One judge used the *VSRI* scoring procedure that only evaluated the targeted pitch skills. Another judge scored the entire performance to determine the validity of the pitch skill scoring system. This was the same technique used in Henry's original study. Intonation was considered accurate if it still served the harmonic function of the scale. The success rates for each skill were then used to rank the skills in order from easiest to most difficult—the higher the success rate, the easier the skill. Following the testing, pitch skills were broken into three categories of increasing difficulty: Level I—Conjunct, Tonic, and Modulatory; Level II—Subdominant and Cadential; and Level III—Dominant, Chromatic, and Larger Leaps. This result conflicted with Henry's previous research using *VSRI*, which found the subdominant pitch-skills to be more difficult than the dominant pitch-skills for vocalists. Alexander and Henry call for further study in this area to see if this hierarchy remains true, despite the subdominant being further removed from the tonic than the dominant. This question will be addressed in the current study. The control for difficulty of key found that students were less successful in E-flat and E Major—the keys with more flats or sharps. This was consistent with what the researchers predicted.

Alexander and Henry's study was the first to examine the difficulty of string sight-reading components. The focus was entirely on pitch and did not account for rhythmic sight-reading difficulty. Their method and materials, particularly their sight-reading melodies incorporating different pitch skills, were very well thought out and will be used as a basis for this study. As Alexander and Henry point out, however, further research is needed to see if their results remain consistent with a wider variety of ability levels. In the present study, Alexander and Henry's hierarchy will be applied to a variety of ability levels in the high school string classroom and not solely high achieving students.

The three string-focused studies examined here reflect the limited amount of research pertaining to the string classroom. All three call for further studies in the area to drive educators toward string pedagogy that is rooted in proven research results.

CHAPTER 3

METHODOLOGY AND PROCEDURES

Subjects

The subjects (*N* = 31) in the study attended a public suburban high school in Cobb County, northwest of Atlanta, Georgia. The school comprised students from middle to upper socioeconomic status. All subjects were orchestra students who had elected to take an extra study period in orchestra twice a week and who then volunteered to participate in the study. No child in the study period was required to participate, and students not choosing to participate in the study were included in the instruction periods but had no data collected. This study period met twice a week for 40 minutes in addition to their daily orchestra class, which met for 55 minutes. The students in the extra study period were from three different orchestra classes and represented varying instrumental abilities.

Of the students involved in the study, 38.71% (*n* = 12) were in ninth grade, 19.35% (*n* = 6) in tenth grade, 38.71% (*n* = 12) in eleventh grade, and 3.23% (*n* = 1) in twelfth grade. All students began playing in the sixth grade. Of the total *N*, 48.39% (*n* = 15) played violin, 19.35% (*n* = 6) played viola, 19.35% (*n* = 6) played cello, and 12.9% (*n* = 4) played bass. The majority of the students were female (*n* = 18). Ages ranged from 13 to 18, with the majority of the students between the ages of 14 and 17 (See Table 1). All students and guardians included in the study signed a release letter from the University of Georgia and Cobb County institutional review boards.

Students completed a questionnaire prior to the study that indicated whether private lessons had ever been taken, as well as past music theory and formal singing training. The majority of the students (*n* = 24) had never taken private lessons. Additionally, only 10 students (32.26%) had ever received theory training beyond the regular orchestra classroom and only 8 students (25.81%) had received formal singing training. There was no attrition from the study—all 31 students who took the initial questionnaire and pretest completed the posttest.

Table 1. Age distribution

Age	*Frequency*	*Percent*
13	1	3.23
14	8	25.81
15	7	22.58
16	9	29.03
17	5	16.13
18	1	3.23

Current Study Design

The study consisted of a two-group pretest-posttest design. All subjects were given an initial pretest using the sight-reading test designed by Alexander and Henry. Following the pretest, students were randomly assigned to the control group or experimental group. Both groups were taught the same material through discussion, instrumental modeling, and instrumental performance. Material was presented sequentially using the Alexander and Henry Pitch-Skill Hierarchy. The independent variable of the study was the use of sight-singing techniques within the experimental group. After eight weeks of treatment, the subjects completed a posttest that again used the sight-reading test designed by Alexander and Henry. The posttest performance was the dependent variable in this study.

The first research question, “Did structured instruction in sight-singing significantly improve instrumental sight-reading?” was answered by the results of the posttest of the control and experimental groups. The posttests, when compared to the Alexander and Henry Pitch Skill Hierarchy, also answered the third research question, “Did the performance of high school string players of varied ability, after receiving structured instruction in sight-singing, validate the Pitch-Skill Hierarchy established by Alexander and Henry?” The second research question, “Is the Alexander and Henry Pitch-Skill Hierarchy (2012) valid for high school string players of varying instrumental sight-reading ability?” was answered by comparing the pretest scores to the Alexander and Henry Pitch-Skill Hierarchy. Finally, the fourth research question, “Do factors beyond the control of the experiment, such as gender, grade level, private lessons, theory instruction, and previous instruction in singing, have any influence on the students’ instrumental sight-reading ability?” was addressed by the student questionnaire and the posttest results.

Measurement Procedures

Alexander and Henry Sight-Reading Test. The pretest and the posttest for the current study utilized the string sight-reading pitch skill hierarchy outlined by Michael Alexander and Michele Henry in their 2012 study. The hierarchy was adapted for strings from the Vocal Sight-Reading Inventory (VSRI) that was initially developed by Henry in 2001. The VSRI consisted of 28 pitch skills (tonal patterns) commonly used in tonal music in major keys. The pitch skills were ranked by difficulty from ascending and descending step-wise motion to skips and leaps within tonic, dominant, and subdominant chords, to cadential, modulatory, and chromatic patterns. Each pitch skill was labeled by its solfege pitches and contained one to seven pitches. Henry developed two versions of the VSRI for researchers and practitioners to use to evaluate sight-reading ability. In the first, the 28 pitch skills were leveled and presented in increasing order of difficulty that allowed researchers to stop the singer when it became too difficult. In the comprehensive version, all 28 pitch skills were included in a small number of melodies. Within the individual melodies, pitch skills were presented in increasing order of difficulty. The test was given in its entirety to evaluate all skills as quickly as possible. By using the VSRI, researchers and educators were able to diagnose students' performance on specific pitch skills. Other often-used tests, such as the Watkins-Farnum Performance Scale, only assess "subjects' holistic ability to sight-read" (p. 203).

Alexander and Henry adapted the VSRI to be used by string players. They kept the initial 28 pitch skills and added three more to include large leaps that are more common in instrumental music than in vocal music. The 31 pitch skills were labeled using solfege abbreviations (d=do, r=re, etc.) and grouped by category. The pitch-skill categories were conjunct (adjacent), tonic, dominant, subdominant, cadential, modulatory, chromatic, and larger leaps (Table 2).

Alexander and Henry then created six six- to eight-measure melodies that included all 31 pitch-skills. As in the VSRI, within an individual melody, pitch skills were presented in increasing order of difficulty. To determine how key affects sight-reading performance, the melodies were written in D Major to represent an open string key, E-Flat Major to represent a flat key, and E Major to represent a sharp key. To allow the different pitch skills to be represented in each key, three different versions of the test were created. Over the three versions, the same six melodies appeared in every key and all three keys were present in each version.

Table 2. Inventory of pitch skills adapted from the VSRI for Alexander and Henry study

	Conjunct		**Subdominant**
1	Repeated		*fld* (IV)
	drm	15	Skip
2	Ascending	16	Leap
3	Descending		*rfl* (ii)
	drmfs	17	Skip
4	Ascending	18	Leap
5	Descending		*ldm* (vi)
	drmfslt	19	Skip
6	Ascending	20	Leap
7	Descending		
			Cadential
	Tonic	21	End on *d*
	dms (I)	22	*t, d*
8	Skip	23	*s, l, t, d*
9	Leap	24	*s, d*
10	*d d'*		
			Modulatory
	Dominant	25	Sharp-*f s* (V/V)
	str (V)	26	Flat-*m*
11	Skip		
12	Leap		**Chromatic**
	strf (V7)	27	Upper neighbor
13	Skip	28	Lower neighbor
14	Leap		
			Larger Leaps
		29	*d l*
		30	*d t*
		31	*r t*

Alexander and Henry also established a scoring procedure for the string test based on the VSRI. Only the pitches labeled as part of the pitch skill being tested were evaluated. All pitches within the specific pitch skill had to be played correctly to receive credit. The 31 targeted skills were scored once for a high score of 31. Alexander and Henry tested the validity of this system by using an alternate scoring system. In the alternate system, one scorer graded every note, not just the targeted pitch skills. The Pearson correlation between the two scoring system was .95

showing that the scoring system was highly valid. Therefore, the targeted pitch skill scoring system was used in this study.

Alexander and Henry Pitch-Skill Hierarchy. Alexander and Henry's 2012 study that utilized their Sight-Reading Test led to the development of their pitch-skill hierarchy for string players. The hierarchy groups the 31 pitch skills by category: Conjunct, Tonic, Dominant, Subdominant, Cadential, Modulatory, Chromatic, and Larger Leaps. The hierarchy was created by averaging the overall success rate for each pitch-skill category and then ranking them in order of difficulty from low to high. The results are presented in Figure 1. The hierarchy for string players did differ slightly from that of vocalists and the results of the VSRI. For both string players and vocalists, conjunct and tonic pitch skills were easier than dominant and chromatic pitch skills. Surprisingly, string players had an easier time than vocalists with subdominant pitch-skills. String players found dominant pitch-skills to be slightly more difficult. Additionally, modulatory pitch-skills presented less of a challenge for string players than vocalists. Alexander and Henry hypothesized these differences were due to the use of open strings and learned finger patterns on string instruments.

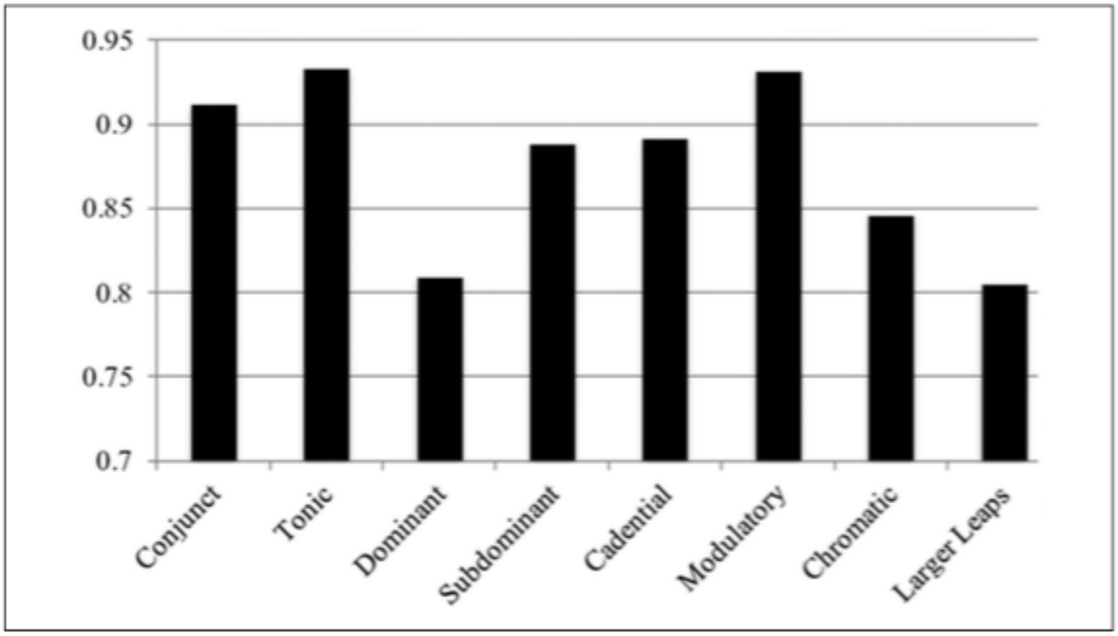
The result of Alexander and Henry's study provided the following hierarchy for string players:

Level I—Tonic, Modulatory, and Conjunct (90% success rate or higher)

Level II—Cadential and Subdominant (85-90% success rate)

Level III—Chromatic, Dominant, and Larger Leaps (85% and below)

Figure 1. Success rates for pitch-skill categories from Alexander and Henry study



Note: Decimal numbers represent the percentage of participants who sight-read the pitch-skill correctly.

Procedure

Students who volunteered to participate in the study were first given a questionnaire to identify their instrument, gender, grade level, history of private lessons, theory instruction outside of the regular orchestra classroom, and any previous vocal training. They were then given a pretest to ascertain a sight-reading base-line score and to create two relatively equal groups. The pretest used the Alexander and Henry Sight-Reading Test. There were three different versions of the test assigned randomly to students. Each version used the same six melodies transposed into three different keys (D Major, E-flat Major, and E Major).

In a room with only a trained test administrator, participants were given 30 seconds to review and practice each melody of the pretest before it was recorded. Trained test administrators assigned a number to the student and read all directions from a script. The recordings were audio only and introduced by the test administrator using the assigned student number. After all students recorded the six melodies, the researcher and two other local area high school orchestra directors graded the pretests.

The pretests were graded using the system established by Alexander and Henry. Each melody consisted of pitch-skills numbered by difficulty from 1 to 31. Students were graded on the accuracy of each individual pitch-skill and nothing else. If a note was played incorrectly but was not part of a graded pitch skill, it did not negatively impact the score. Rhythm and tempo were not evaluated, only pitch. For each correct pitch skill, students earned one point. A perfect score was 31 points.

Following the grading of the pretest, students—still only identified by their assigned number—were ranked from the highest to the lowest score. To divide the groups randomly and as equally as possible, the top two scores were split into the control or experimental group by the flip of a coin. When the coin landed heads up, the first student went to the control group and the second went to the experimental group. When the coin landed tails up, the first student went to the experimental group and the second went to the control group. This was continued with every pair of students. Because there was an uneven total number (31), the last student's group was decided by coin flip and went to the control group. The average score on the pretest for the control group was 17.81 and the average score of the experimental group was 17.60.

The researcher taught both the control and the experimental group. Both groups were given 15-minute lessons twice a week for eight weeks. Due to scheduling conflicts at the school beyond the researcher's control, the eight weeks of instruction were spread out over the course of eleven weeks. Lesson plans were created by the researcher and can be seen in Appendix F.

Musical examples were either from Dabcyznski, Meyer, and Phillips' *Sight-Read It for Strings* (2006) or were created by the researcher (Appendix G). For both groups, sight-reading techniques were taught in the sequential order outlined by the VSRI and the Alexander and Henry study (Table 2).

The control group was introduced to each new sight-reading topic by the researcher through discussion and modeling. New pitch-skills were played by the researcher for students to echo on their instrument. The control group played exercises together that utilized the new topic and the researcher gave feedback or pointed out difficult passages for students to play again. Students were then given 30 seconds to individually practice melodies that utilized the new topic before performing them as a group. This approach imitated the sight-reading test procedure. The exercises and melodies all focused on the keys of D Major, E-flat Major, and E Major that were utilized by Alexander and Henry.

The experimental group was taught identically to the control group with the addition of sight-singing techniques. Students were first taught movable-do solfege. The researcher sang each new pitch-skill for students to echo vocally and on their instrument. Students sang each exercise on solfege before they performed it on their instrument. As with the control group, the researcher gave feedback or pointed out difficult passages for students to play again. The experimental group students were also given 30 seconds to individually practice the new melodies and they were encouraged to sing as well as play during that time. The exercises and melodies used by the control group were the same as those used by the experimental group.

Following the instruction period, all students were given a posttest. The posttest again utilized the Alexander and Henry Sight-Reading Test. Students received a different version of the posttest than they had played on the pretest. A student that played Test 1 in the pretest played

Test 2 in the posttest. A student that played Test 2 in the pretest played Test 3 in the posttest. A student that played Test 3 in the pretest played Test 1 in the posttest. The distribution of test versions can be seen in Table 3.

Table 3. Pretest and posttest distribution

	Posttest Version			
Pretest Version	*1*	*2*	*3*	*Total*
1	0	12	0	12
2	0	0	10	10
3	9	0	0	9
Total	9	12	10	31

Posttest procedure was identical to pretest procedure. Students were assigned their same number for the recordings that they had been assigned in the pretest. The trained test administrators read from the same script that provided each student with 30 seconds to practice each melody before recording it. The researcher and the same orchestra directors graded the posttests using Alexander and Henry's targeted pitch-skill scoring system.

Data Analysis

All data were analyzed using the SAS version 9.3. A *t*-test was used to find statistical significance between the pretest and posttest with the independent variable being the treatment method and the posttest result of the Alexander and Henry Sight-Reading Test being the dependent variable. A general linear model (GLM) was used to find the effect of pretest score, age, and instrument on the posttest score.

Time Line

The timeline below demonstrates this study's organization and sequencing. All instruction and testing was done during the school day.

Week of January 5th	Students informed of study
Week of January 12th	Student and parent consent forms due
January 20th and 22nd	Pretest administered
January 24th	Pretest graded
Weeks of February 2nd-Feburary 16th	First three weeks of instruction given
Weeks of March 2nd- March 9th	Week 4 and 5 of instruction given
Weeks of March 23rd-March 30th	Week 6 and 7 of instruction given
Week of April 13th	Week 8 of instruction given
April 21st and 23rd	Posttest administered
April 24th	Posttest graded
May-mid-June	Data analyzed

CHAPTER 4

RESULTS

Introduction

The results reported in this chapter are arranged by research question. Data were collected from students' pre- and posttests as well as the experience questionnaire. The independent variable in the study was the treatment method used and the results of the posttest served as the dependent variable. A *t*-test was used to compare the posttests of the two groups. Percentages of correctly performed pitch-skills from both the pre- and posttest were used to compare the participant's performances to those used for the Alexander and Henry Pitch-Skill Hierarchy. Statistics were computed using the Statistical Package for the Social Sciences (SPSS) Software at the University of Georgia.

Research Question 1

Of the 31 students that participated in the study, 16 were in the experimental group that received in sight-singing instruction and 15 were in the control group that did not. Table 4 the raw data of pre- and posttest scores for the control and experimental group. Table 5 shows the pre and posttest data for the entire group of students and also for the control and experimental group. The mean for both groups was 17.71 out of a potential 31 points with a standard deviation of 7.23. After the groups were randomly divided, the experimental group had a slightly lower mean at 17.60 but a lower degree of variation with the standard deviation at 6.84. The control group had a slightly higher mean at 17.81 but a wider spread of scores with a standard deviation of 7.79. The posttest average of both groups showed improvement with an average score of

24.87 out of 31 points. The standard deviation for both groups was 7.01. The experimental group outperformed the control group with a mean score of 25.93 and the smallest spread of scores with a standard deviation of 5.48. The control group scored 23.88 with the largest standard deviation of 8.25.

Using an unpaired *t*-test, the *p*-value equaled 0.4251, showing that the difference between the treatment methods was not statistically significant. The degrees of freedom was 29 with a standard error of difference of 2.534. Structured sight-singing instruction over purely instrumental instruction did not significantly improve instrumental sight-reading performance.

Research Question 2

To answer this question, the pretest results of both groups were compared to the results found in the Alexander and Henry study. In the Alexander and Henry study, each pitch-skill was given a percentage for the number of students that played it correctly. This percentage was the success rate for that pitch-skill. The study then focused on creating a hierarchy by looking at each pitch-skill category. To find the difficulty level of the category, the pitch-skills within each category were averaged to determine the percentage of students that played correctly within the category. The six categories were then ranked in difficulty from the easiest to the hardest to create a hierarchy. The easier categories had a higher success rate than the more difficult categories. From their results, they determined that Conjunct, Tonic, and Modulatory pitch-skills were the easiest (Level I), followed by Subdominant and Cadential (Level II), and finally Dominant, Chromatic, and Larger Leaps (Level III). For their data, Alexander and Henry used high school orchestra students attending an advanced auditioned string summer camp. The majority of the students were all-state players and played at an advanced level.

Table 4. Posttest scores by pitch for control and experimental group

	Control Group		*Experimental Group*	
Pitch	*Posttest # Correct*	*Posttest % Correct*	*Posttest # Correct*	*Posttest % Correct*
1	13	81.25%	14	93.33%
2	13	81.25%	14	93.33%
3	13	81.25%	15	100.00%
4	11	68.75%	12	80.00%
5	14	87.50%	12	80.00%
6	14	87.50%	13	86.67%
7	9	56.25%	12	80.00%
8	14	87.50%	14	93.33%
9	14	87.50%	15	100.00%
10	10	62.50%	13	86.67%
11	10	62.50%	9	60.00%
12	11	68.75%	14	93.33%
13	11	68.75%	9	60.00%
*14**	13	81.25%	11	73.33%
15	12	75.00%	13	86.67%
16	15	93.75%	13	86.67%
17	13	81.25%	13	86.67%
18	15	93.75%	13	86.67%
19	14	87.50%	14	93.33%
*20**	11	68.75%	11	73.33%
21	15	93.75%	14	93.33%
22	13	81.25%	14	93.33%
23	11	68.75%	12	80.00%
24	14	87.50%	13	86.67%
25	12	75.00%	11	73.33%
26	10	62.50%	14	93.33%
27	9	56.25%	12	80.00%
28	10	62.50%	9	60.00%
29	13	81.25%	11	73.33%
30	13	81.25%	11	73.33%
31	12	75.00%	14	93.33%

* Pitch-skills 14 and 20 were not performed in the key of E Major, but the pitches that were performed were considered “equivalent” to these. This continued the approach set forth in the Alexander and Henry study.

Table 5. Student performance on overall pretest and posttest

Group	*N Obs*	*Time*	*Mean*	*Std Dev*
All	31	Pre	17.71	7.23
		Post	24.87	7.01
Control	16	Pre	17.81	7.79
		Post	23.88	8.25
Experimental	15	Pre	17.60	6.84
		Post	25.93	5.48

The pretest of this study was chosen for this comparison because it represented an overall lower ability level than that seen in the previous study. Students had chosen to register for an extended orchestra period but were not required to audition. The 31 participants came from every grade level and exhibited a wide range of playing performance, unlike the advanced players from the Alexander and Henry study. The pretest represented their sight-reading ability level without any specific training beyond that received in their orchestra classroom at both the middle and high school level.

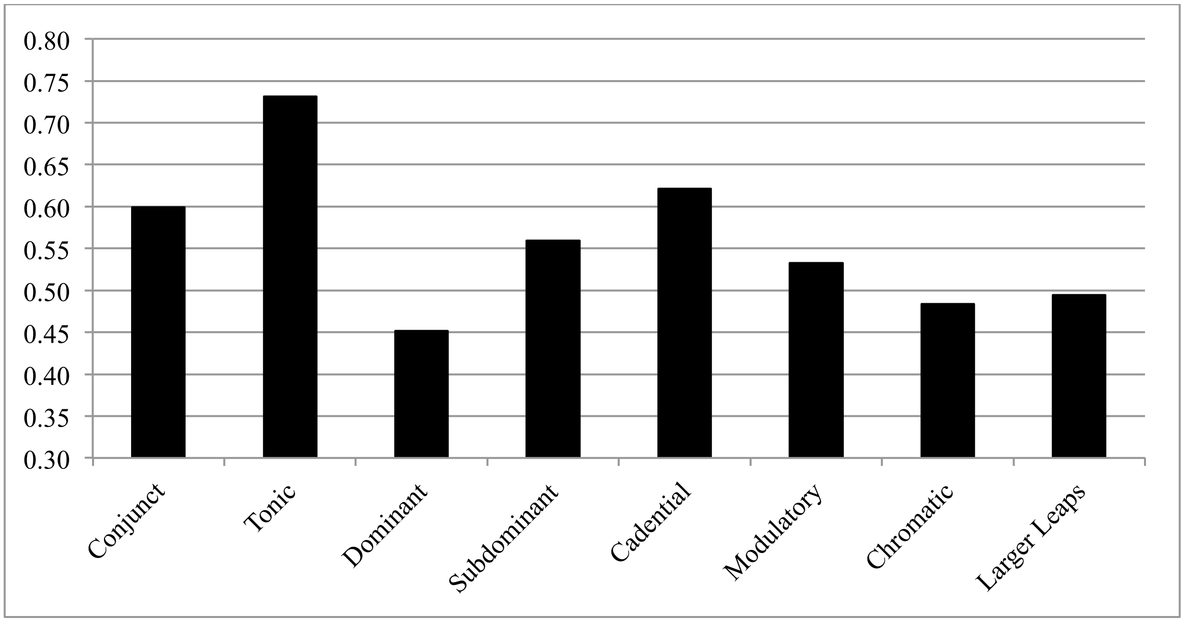
The pretests were scored in the same fashion as the Alexander and Henry scores. Each pitch-skill was given a percentage for the number of students that played it correctly. The results for each pitch-skill can be seen in Table 6. The pitch-skills in each category were then averaged to determine a percentage for each category. These results are seen in Figure 2. By ranking the difficulty level of the pitch-skill categories of the pretest, the categories were divided into their own hierarchy of three levels. Level I, all categories with a success rate over 60%, consisted of Tonic and Cadential pitch-skills. Level II consisted of those categories between 50 and 60%: Conjunct, Subdominant, and Modulatory. Level III, all categories with a success rate below 50%, consisted of Larger Leaps, Chromatic, and Dominant pitch-skills.

Table 6. Pretest results by pitch-skill

Pitch	*Pretest # Correct*	*Pretest % Correct*
1	28	90.32%
2	21	67.74%
3	20	64.52%
4	16	51.61%
5	16	51.61%
6	15	48.39%
7	14	45.16%
8	18	58.06%
9	28	90.32%
10	22	70.97%
11	13	41.94%
12	26	83.87%
13	8	25.81%
*14**	14	45.16%
15	15	48.39%
16	25	80.65%
17	19	61.29%
18	16	51.61%
19	18	58.06%
*20**	11	35.48%
21	27	87.10%
22	10	32.26%
23	16	51.61%
24	24	77.42%
25	14	45.16%
26	19	61.29%
27	20	64.52%
28	10	32.26%
29	16	51.61%
30	11	35.48%
31	19	61.29%

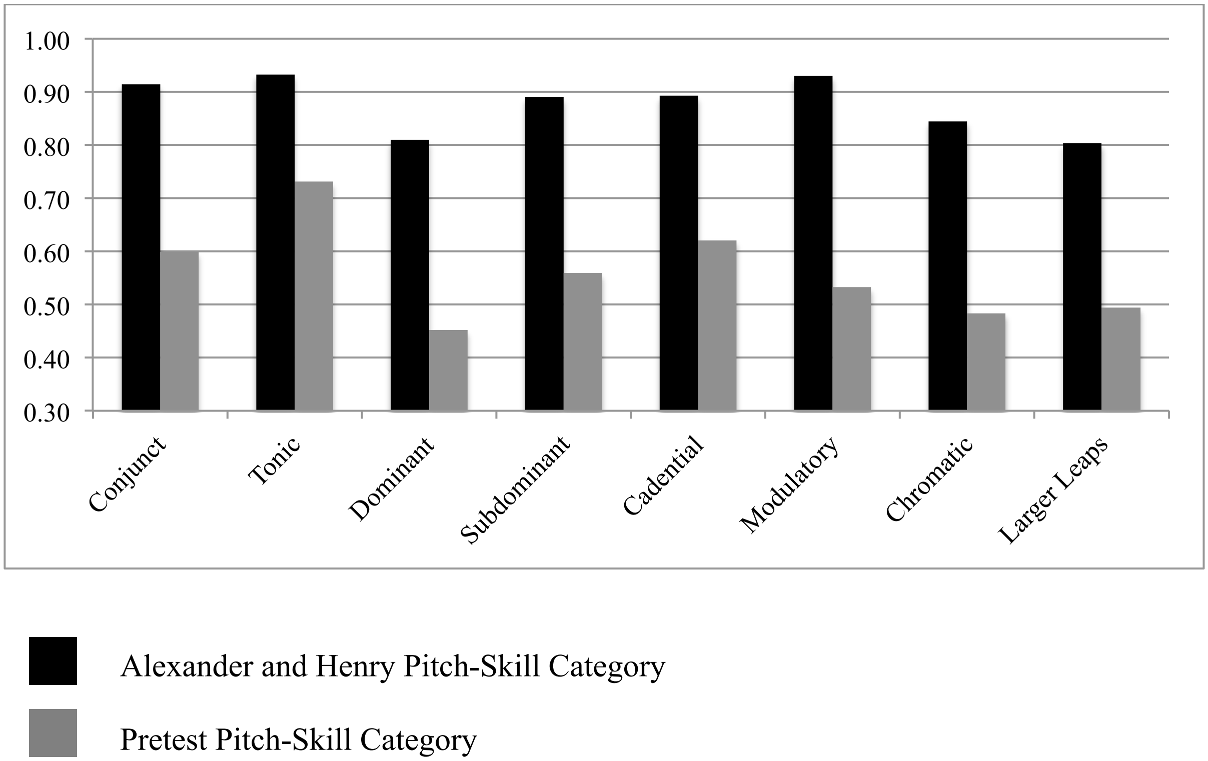
* Pitch-skills 14 and 20 were not performed in the key of E Major, but the pitches that were performed were considered “equivalent” to these. This continued the approach set forth in the Alexander and Henry study.

Figure 2. Success rates for pitch-skill categories from pretest



A comparison of the Alexander and Henry study with the pretest is shown in Figure 3. There were some similarities between the two studies. Tonic pitch-skills were the easiest for both groups and were a Level I pitch-skill for all. The most difficult pitch-skill categories, those in Level III—Larger Leaps, Chromatic, and Dominant—were the same for both studies. Not all difficulty levels of the categories found by Alexander and Henry proved consistent with those in the pretest, however. Specifically, conjunct pitch-skills were considered a Level I category for Alexander and Henry but ranked as a Level II category for the pretest. Modulatory pitch-skills also ranked differently for the two groups. Alexander and Henry found Modulatory pitch-skills to be a Level I difficulty while the pretest considered them to be Level II. The opposite held true for Cadential pitch-skills which were of a Level II difficulty for Alexander and Henry and a Level I difficulty in the pretest. With these differences, the Alexander and Henry Pitch-Skill Hierarchy did not prove valid for students of varying instrumental sight-reading ability.

Figure 3. Success rates for pitch-skill categories: Alexander and Henry study vs. pretest



<u>Research Question 3</u>

For this question, the posttest results of the experimental group were used. The posttest used the students of varied ability seen in the pretest but limited the number to the fifteen that received the structured sight-singing instruction in the experimental group. The results for each pitch-skill for the experimental group can be seen in Table 7. The percentages again represent the number of students that correctly played the pitch-skill.

Table 7. Pitch-skill results from posttest of experimental group

Pitch	*Posttest # Correct*	*Posttest % Correct*
1	14	93.33%
2	14	93.33%
3	15	100.00%
4	12	80.00%
5	12	80.00%
6	13	86.67%
7	12	80.00%
8	14	93.33%
9	15	100.00%
10	13	86.67%
11	9	60.00%
12	14	93.33%
13	9	60.00%
*14**	11	73.33%
15	13	86.67%
16	13	86.67%
17	13	86.67%
18	13	86.67%
19	14	93.33%
*20**	11	73.33%
21	14	93.33%
22	14	93.33%
23	12	80.00%
24	13	86.67%
25	11	73.33%
26	14	93.33%
27	12	80.00%
28	9	60.00%
29	11	73.33%
30	11	73.33%
31	14	93.33%

* Pitch-skills 14 and 20 were not performed in the key of E Major, but the pitches that were performed were considered “equivalent” to these. This continued the approach set forth in the Alexander and Henry study.

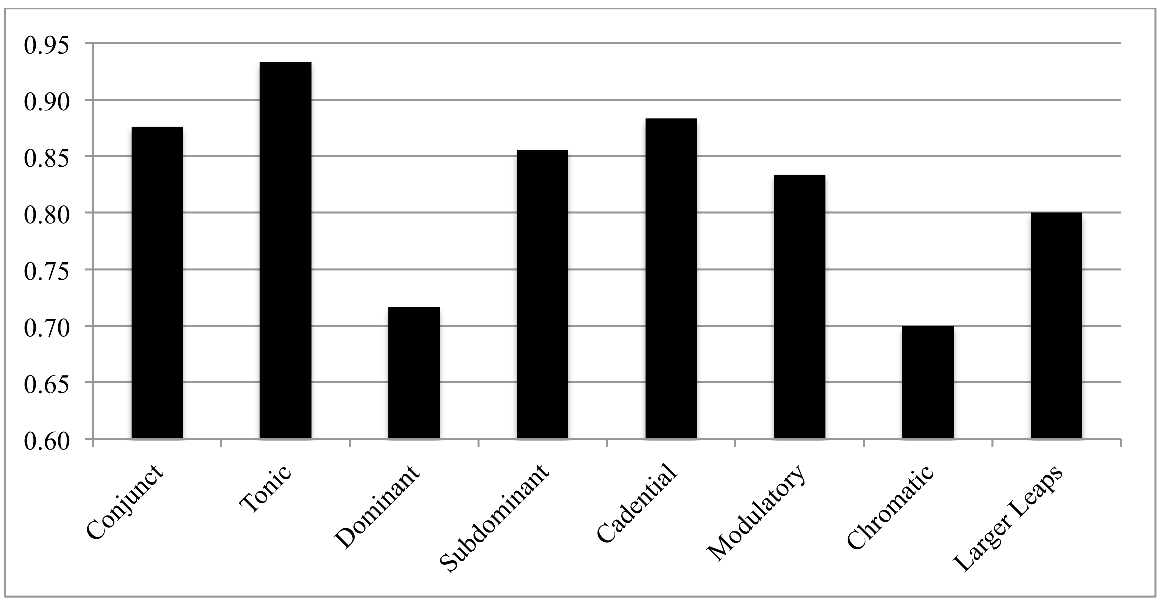
Using the same method of calculations from the pretest, the average for each pitch-skill was calculated. These results can be seen in Figure 4. The percentages indicate a much higher success rate than those shown in the pretest. They also indicate success rates that more closely align with those found in the Alexander and Henry Pitch-Skill Hierarchy. The same success rates were used for the posttest as in the Alexander and Henry study and the following hierarchy was developed:

Level I—Tonic (90% success rate or higher)

Level II—Cadential, Conjunct, and Subdominant (85-90% success rate)

Level III—Modulatory, Larger Leaps, Dominant, and Chromatic (85% and below)

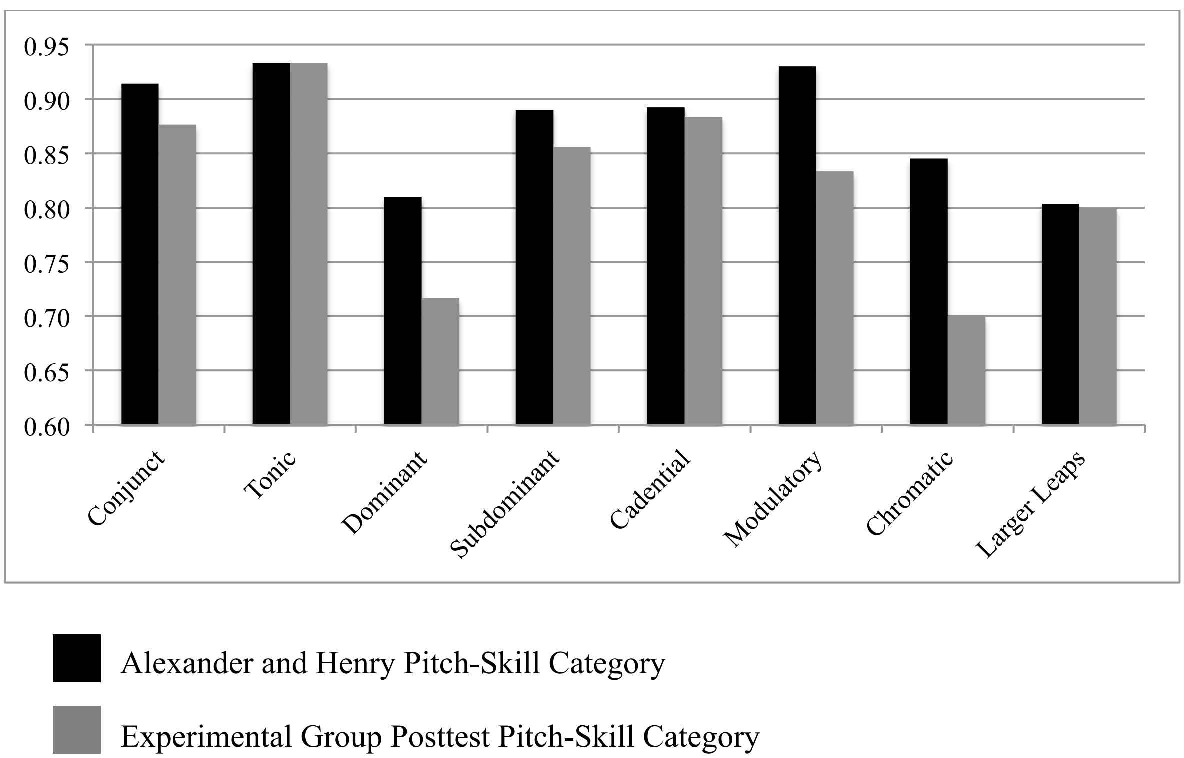
Figure 4. Success rates for pitch-skill categories from experimental group posttest



A comparison of the Alexander and Henry pitch-skill categories with the posttest categories is shown in Figure 5. There are many more similarities between the experimental group's posttest than the pretest. The biggest difference, mentioned previously, is the similar range to the Alexander and Henry Pitch-Skill Hierarchy. The pretest category scores success rates were spread from .45 to .73 while the posttest experimental group success rates spread from

.7 to .93. This is much more closely in line with Alexander and Henry's success rate range of .8 to .93. There are also more commonalities in the ranking of the hierarchies. Tonic pitch-skills were the most successful category in both studies and were of Level I difficulty for both. Both studies also found Chromatic, Dominant, and Larger Leaps to be the three most difficult categories and placed them in the Level III difficulty. Cadential and Subdominant pitch-skills both fell in the Level II category. The differences between the experimental group posttest and the Alexander and Henry Pitch-Skill Hierarchy came with the Modulatory and Conjunct categories. Modulatory pitch-skills were a Level I difficulty for Alexander and Henry and Level III difficulty for the present study. The Conjunct pitch-skill success rate was slightly different with a Level I difficulty for Alexander and Henry and a Level II difficulty for the experimental group's posttest.

Figure 5. Success rates for pitch-skill categories: Alexander and Henry study vs. posttest



Although the hierarchy created from the singing group's posttest was more similar to the Alexander and Henry hierarchy than the pretest, there were still key differences in pitch-skill success rates. This study did not validate the pitch-skill hierarchy set forth by Alexander and Henry.

Research Question 4

To determine the answer to this question, a general linear model (GLM) with a stepwise selection process was used on the students' posttest scores. The GLM looked at all students' scores and did not separate control and experimental group. Each variable was considered individually to see what had the most significance on the posttest score. If a variable showed significance, it was added to the model in order. Variables were only added if the *p*-values that accompanied them were less than 0.05. The *p*-value is the probability that there is a relationship between the independent and dependent variable of the sample. If a variable that was previously significant became insignificant when a new variable was added, it was removed.

Each of the variables from the student questionnaire was input into the GLM. These included age, grade level, instrument, private lessons, music theory training beyond the orchestra classroom, and formal singing training. The GLM also accounted for the students' pretest score. Only three of the variables were found to be statistically significant: pretest score, age, and instrument. Their significance is shown in Table 8. The degrees of freedom (DF) is shown as the number of levels minus 1 (for instrument) or as 1 for continuous variables, like pretest and age. The *F*-value is the statistic that is calculated to determine whether there is a significant effect of each of the independent variables. The *F*-value is interpreted through the use of the *p*-value. The table also includes the group (control or experimental) which again shows that the treatment did not have a statistically significant effect on the posttest score because the *p*-value is over 0.05.

Table 8. Overall significance of demographic variables including group

Source	*DF*	*F-value*	*p-value*
Pretest Score	1	29.52	<0.0001
Age	1	7.49	0.0115
Instrument	3	5.14	0.0069
Group	1	0.13	0.7185

Tables 9 and 10 show the effect pretest score and age had on the posttest. For each additional point on the pretest score across students, the posttest score increases by an average of 0.5895 points. The standard error is a way of measuring how close this estimate might be to the true effect. For each additional year in age across students, the posttest score increases by an average of 1.6447 points.

Table 9. Effect of pretest score

Variable	*Est. Parameter*	*Standard Error*
Pretest Score	0.5895	0.1046

Table 10. Effect of age

Variable	*Est. Parameter*	*Standard Error*
Age	1.6447	0.5952

The instrument also had an effect on the posttest score. Table 11 shows that the average posttest score (assuming average age and average pretest) greatly varied by instrument. Bass players had a significantly lower posttest score than cello and violin. Assuming a bass player and a cellist had the same pretest score, the bass player would score much lower in the posttest.

Table 11. Effect of instrument

Instrument	*Average Posttest*
Cello	27.52
Violin	26.58
Viola	22.46
Bass	18.12

Using the data from the GLM, it is clear that age and instrument do have a significant effect on a student's instrumental sight-reading ability. Though not previously considered, the pretest also had a significant effect. Factors such as gender, grade level, private lessons, additional theory instruction, and previous singing instruction did not have an effect.

Other Findings

Much like in Alexander and Henry's study, the key of the sight-reading example had an impact on the students' performance. Tables 12 and 13 show the student's pretest and posttest scores with a breakdown by key for each pitch-skill. Students scored highest on pitch-skills in D Major than in E Major and E-flat Major on both tests. Figures 6 and 7 show how the pitch-skill categories of the pretest and posttest compare when separated by key signature.

To further study the effect of the key signature, the Alexander and Henry Sight-Reading Test was divided into sections based on key. Of the six melodies, the first and fourth were in the same key, the second and fifth were in the same key, and the third and sixth were in the same key. The key of the melodies was determined by the version of the test. A linear mixed effects analysis was done showing the effect of multiple sections and key signatures, but maintaining the same pretest score, grade level, age, etc. The result, shown in Table 14, is that section and key did influence the outcome of the posttest. Because of the mixed effects approach to the model, denominator degrees of freedom differ according to the variable. The section and key score are both have a p-value below 0.05 and are therefore significant. The same test was run with the variable of group and again the group was not found to be statistically significant. This indicates that while key did make a difference in the overall posttest scores by section, it did not influence how the experimental group performed relative to the control group.

A post hoc analysis was also run on the different sections of the test. Students scored higher on sections in the key of D Major than either E ($t(56) = 24.25$, $p = 0.0044$) or E-Flat Major ($t(56) = 3.56$, $p = 0.0022$). Both *p*-values were adjusted according to the Tukey Honest Significant Difference (HSD) adjustment. There was no significant difference between the key of E Major and E-Flat Major.

Table 12. Percentage of students correct by pitch-skill and key signature, pretest

	Number of Students			*Percent Correct*		
Pitch	*Key = D*	*Key = E*	*Key = Eb*	*Key = D*	*Key = E*	*Key = E-Flat*
1	12	9	10	100.00%	100.00%	70.00%
2	9	10	12	88.89%	60.00%	58.33%
3	12	9	10	91.67%	44.44%	50.00%
4	9	10	12	88.89%	50.00%	25.00%
5	10	12	9	100.00%	25.00%	33.33%
6	10	12	9	80.00%	33.33%	33.33%
7	12	9	10	75.00%	11.11%	40.00%
8	9	10	12	88.89%	50.00%	41.67%
9	10	12	9	100.00%	100.00%	66.67%
10	9	10	12	88.89%	80.00%	50.00%
11	12	9	10	25.00%	11.11%	90.00%
12	12	9	10	91.67%	77.78%	80.00%
13	10	12	9	10.00%	25.00%	44.44%
*14**	10	12	9	80.00%	33.33%	22.22%
15	9	10	12	66.67%	60.00%	25.00%
16	10	12	9	90.00%	91.67%	55.56%
17	9	10	12	77.78%	90.00%	25.00%
18	9	10	12	77.78%	50.00%	33.33%
19	12	9	10	83.33%	44.44%	40.00%
*20**	10	12	9	70.00%	16.67%	22.22%
21	12	9	10	100.00%	88.89%	70.00%
22	9	10	12	33.33%	20.00%	41.67%
23	12	9	10	58.33%	33.33%	60.00%
24	10	12	9	100.00%	75.00%	55.56%
25	9	10	12	55.56%	50.00%	33.33%
26	12	9	10	83.33%	77.78%	20.00%
27	12	9	10	83.33%	66.67%	40.00%
28	10	12	9	20.00%	16.67%	66.67%
29	9	10	12	66.67%	60.00%	33.33%
30	9	10	12	33.33%	30.00%	41.67%
31	12	9	10	75.00%	22.22%	80.00%

Table 13. Percentage of students correct by pitch and key signature, posttest

	Number of Students			*Percent Correct*		
Pitch	*Key = D*	*Key = E*	*Key = Eb*	*Key = D*	*Key = E*	*Key = E-Flat*
1	9	10	12	100.00%	100.00%	66.67%
2	10	12	9	100.00%	66.67%	100.00%
3	9	10	12	88.89%	100.00%	83.33%
4	10	12	9	100.00%	66.67%	55.56%
5	12	9	10	91.67%	77.78%	80.00%
6	12	9	10	91.67%	77.78%	90.00%
7	9	10	12	88.89%	70.00%	50.00%
8	10	12	9	100.00%	75.00%	100.00%
9	12	9	10	91.67%	88.89%	100.00%
10	10	12	9	80.00%	75.00%	66.67%
11	9	10	12	77.78%	50.00%	58.33%
12	9	10	12	88.89%	90.00%	66.67%
13	12	9	10	75.00%	44.44%	70.00%
*14**	12	9	10	83.33%	66.67%	80.00%
15	10	12	9	100.00%	83.33%	55.56%
16	12	9	10	100.00%	66.67%	100.00%
17	10	12	9	100.00%	83.33%	66.67%
18	10	12	9	90.00%	91.67%	88.89%
19	9	10	12	88.89%	100.00%	83.33%
*20**	12	9	10	66.67%	66.67%	80.00%
21	9	10	12	100.00%	100.00%	83.33%
22	10	12	9	100.00%	75.00%	88.89%
23	9	10	12	88.89%	70.00%	66.67%
24	12	9	10	91.67%	77.78%	90.00%
25	10	12	9	100.00%	58.33%	66.67%
26	9	10	12	88.89%	70.00%	75.00%
27	9	10	12	77.78%	80.00%	50.00%
28	12	9	10	41.67%	55.56%	90.00%
29	10	12	9	100.00%	75.00%	55.56%
30	10	12	9	100.00%	75.00%	55.56%
31	9	10	12	77.78%	90.00%	83.33%

Figure 6. Success rates for pitch-skill categories with effect of key in pretest

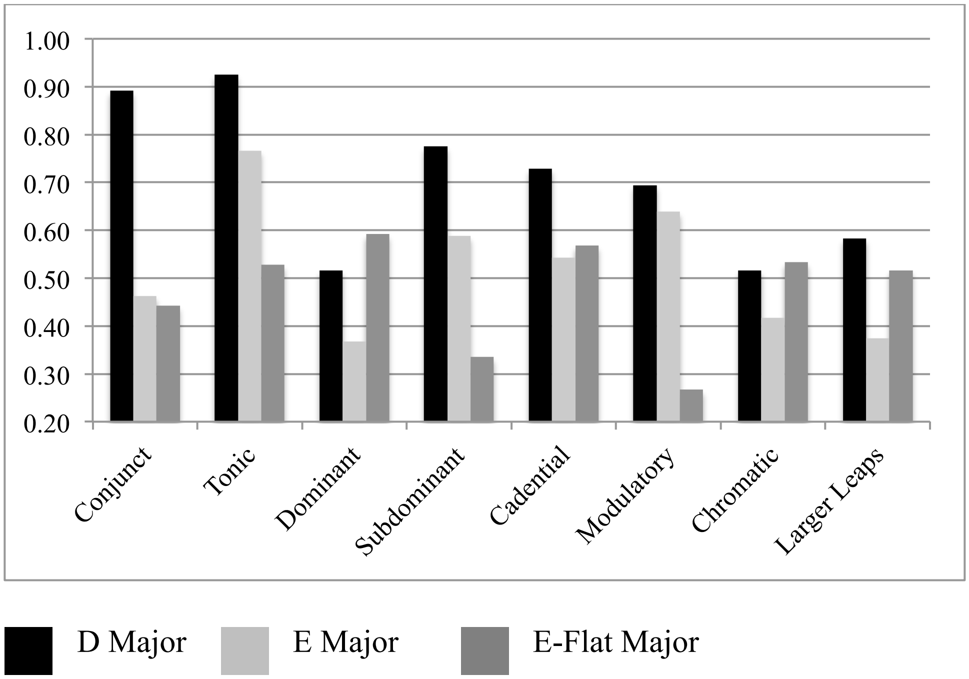


Figure 7. Success rates for pitch-skill categories with effect of key in posttest

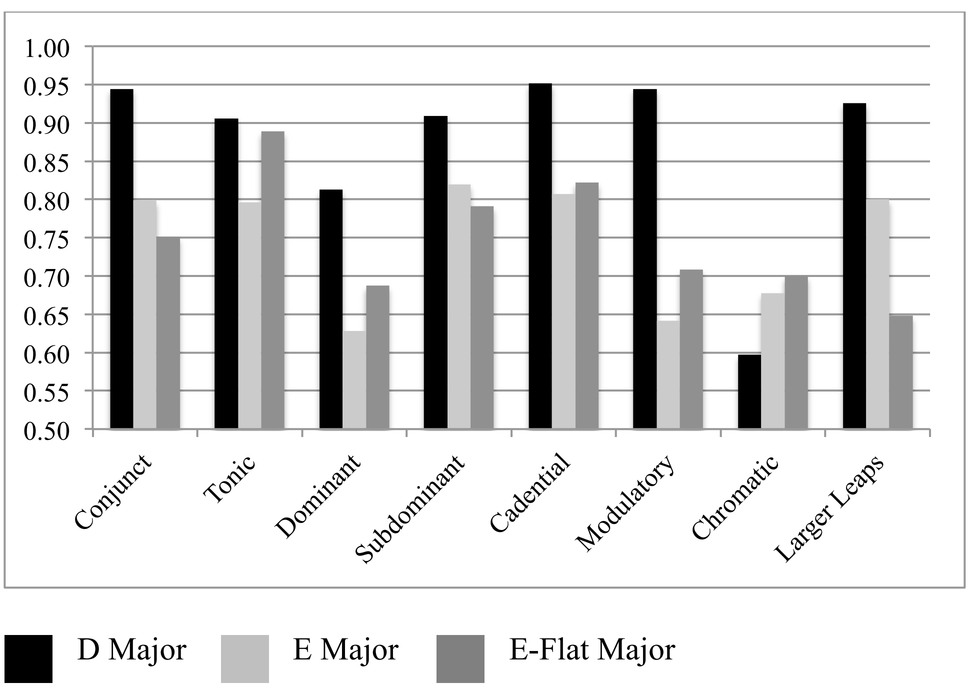


Table 14. Overall significance of variables including section and key

Variable	*Num DF*	*Den DF*	*F-value*	*p-value*
Pretest Score	1	25	31.69	<0.0001
Section	2	58	14.52	<0.0001
Key	2	58	8.14	0.0008
Instrument	3	25	6.05	0.0106
Age	1	25	7.64	0.0030

CHAPTER 5

SUMMARY, DISCUSSION, AND CONCLUSIONS

Summary

The purpose of this study was to determine the effect of structured vocal sight-singing instruction on instrumental sight-reading performance. Additionally, the study compared the results of varied ability high school orchestra students with those of high ability in the difficulty of sight-reading different pitch-skill categories. Four research questions were discussed: (1) Did structured instruction in sight-singing significantly improve instrumental sight-reading? (2) Is the Alexander and Henry Pitch-Skill Hierarchy (2012) valid for high school string players of varying instrumental sight-reading ability? (3) Did the performance of high school string players of varied ability, after receiving structured instruction in sight-singing, validate the Pitch-Skill Hierarchy established by Alexander and Henry (2012)? (4) Do factors beyond the control of the experiment, such as gender, age, grade level, private lessons, theory instruction, and previous instruction in singing, have any influence on the students' instrumental sight-reading ability?

Thirty-one high students from a Georgia high school served as subjects for this study. These subjects were all members of an orchestra extension period that meant twice a week in addition to their daily orchestra class. All subjects were volunteers. The subjects attended a high school comprised of students of middle to upper class socio-economic status. The sample consisted of 58.06% female and 41.94% male students. Students were 13 to 18 years of age with the majority (77.42%) being between the ages of 14 and 16. The majority of the students (48.39%) played violin, with 19.35% playing viola, 19.35% playing cello, and 12.90% playing bass. 51.61% of the subjects were in the experimental group and 48.39% were in the experimental group.

The Alexander and Henry Sight-Reading Test, created and tested for validity and reliability for their 2012 study on instrumental sight-reading, was used to measure sight-reading performance for the pre- and posttest. This test graded 31 specific pitch-skills for accuracy within six eight-measure sight-reading examples in D Major, E-Flat Major, and E Major. The performances were recorded and then graded by the researcher and two local orchestra teachers for accuracy of each labeled pitch-skill. Information regarding years of experience on their instrument, theory training outside of the orchestra classroom, and previous vocal experience was collected using a questionnaire.

Following the pretest, students were divided randomly into a control and experimental group of relatively equal ability level. Over a period of eight weeks, students received biweekly instruction on sight-reading. The control group received instruction solely on their instrument. Information was delivered through discussion and instrumental modeling. The experimental group received instrumental instruction as well as sight-singing instruction using movable-do solfege syllables. Information was delivered through discussion and vocal and instrumental modeling. Following the treatment period, the two groups were tested again. The data of the posttest were compared using a *t*-test to determine if there was a statistical significance between the control and experimental group.

The pretest and posttest results were also compared to the Alexander and Henry Pitch-Skill Hierarchy. This hierarchy, created from their 2012 study, ranked the difficulty level of pitch-skill categories. The pitch-skill categories—Conjunct, Tonic, Dominant, Subdominant, Cadential, Modulatory, Chromatic, and Larger Leaps—were comprised of two to seven pitch-skills each. The difficulty level of each category was determined by averaging the percentage of correct pitch-skills played by all subjects within that category. A higher percentage represented an easier difficulty level. The Alexander and Henry Pitch-Skill Hierarchy established that there were three levels of difficulty in string sight-reading. Level I, the easiest level, consisted of Conjunct, Tonic, and Modulatory pitch-skills. Level II consisted of Subdominant and Cadential pitch-skills. Level III, the most difficult, consisted of Dominant, Chromatic, and Larger Leaps. Using the same method as Alexander and Henry, the results of the pre- and posttest were used to determine the difficulty level of each pitch-skill category. The percentage of correct pitch-skills was averaged for each category. The hierarchies developed from the pre- and posttests were then compared to the hierarchy of the Alexander and Henry study to determine if the levels of difficulty were consistent for all string players.

Discussion

The purpose of this study was to determine whether structured vocal sight-singing instruction combined with instrumental sight-reading instruction was more effective than instrumental sight-reading instruction on its own. The study also evaluated the validity of the Alexander and Henry Pitch-Skill Hierarchy with the performance of students with varied playing ability. The results of this study show that instrumental sight-reading instruction is not significantly more effective when combined with vocal sight-singing instruction. The study also showed that the Alexander and Henry Pitch-Skill Hierarchy is not transferable to students of varied ability levels, both before and after structured sight-reading instruction.

Research question 1: Did structured instruction in sight-singing significantly improve instrumental sight-reading? An examination of the *t*-test comparing the control and experimental groups shows that the difference between the two groups was not statistically significant. The mean score of the experimental group receiving vocal instruction was higher than the control group but it was not enough to prove statistically significant. Significance level for the test was 0.43, well over the 0.05 *p*-value necessary to prove significance.

Although the vocal sight-singing treatment did not prove statistically significant, it did confirm what has been found in other studies. The students receiving vocal and instrumental instruction did so in the same amount of time as their instrument-only counterparts. The time devoted to vocal instruction did not take away from their playing ability, in fact, it added to it. This holds consistent with the research of McGarry (1967) and Dunlap (1989). Both studies were conducted with beginning band students and found that vocal training improved performance ability on wind instruments but not significantly. McGarry and Dunlap concluded that the vocal training did help students and, as seen in this study, that the time spent singing and not playing did not negatively impact performance.

Dunlap further concluded that with an increased treatment period, vocal instruction might be shown to have a significant effect over solely instrumental instruction. The same is true here. The treatment period, twice a week for eight weeks, was incredibly short. Also, due to circumstances beyond the researcher's control, the eight-week treatment period was stretched out over a period of eleven weeks. This extension of the treatment period meant that subjects were not provided with the consistency of vocal sight-singing practice. Providing consistent weekly or daily sight-singing practice and extending the treatment period could lead to a higher instrumental sight-reading performance.

The Alexander and Henry Sight-Reading Test used for this study did not account for intonation. The test was only concerned if all the notes in a specific pitch-skill were accurate. If a note was slightly out of tune but still considered to be the correct pitch, the student earned a point. By not considering intonation, the test does not evaluate string players in the same way the studies of Dell (2003) and Frank (2006) did. Both Dell and Frank found that the addition of vocal instruction significantly improved string players' intonation on prepared repertoire. Their methods of evaluation rated intonation accuracy through the *Intonation Performance Index* or a scale of 1 to 5, respectively.

By not accounting for intonation accuracy in this study, it is not possible to know whether the control or experimental group played more in tune. If the findings of Dell and Frank hold true, the experimental group that utilized vocal instruction would play significantly more in tune than the group receiving only instrumental instruction. Adding an intonation measure, like the ones found in the Dell and Frank studies, on top of the Alexander and Henry Sight-Reading Test would provide more insight into whether vocal instruction improves instrumental sight-reading. It would also transfer the findings of Dell and Frank to string sight-reading from prepared repertoire.

Research Question 2: Is the Alexander and Henry Pitch-Skill Hierarchy (2012) valid for high school string players of varying instrumental sight-reading ability? By comparing the success rates for pitch-skill categories of the Alexander and Henry study with those of the pretest, the Alexander and Henry Pitch-Skill Hierarchy was proved to be invalid for students of varying instrumental sight-reading ability. The Alexander and Henry study tested 94 subjects. All students had been auditioned to attend an elite summer orchestra camp and most were at an all-state high school level of playing ability. This study tested 31 students of varying abilities. Of the 31 students, none had previously been accepted into an orchestra at all-state or comparable level. In Alexander and Henry's study they specifically call for further research to be done using students of a different ability level. This study shows that their hierarchy is not directly transferable to all ability levels.

The sample size of this study, especially when compared to the Alexander and Henry study, is relatively small. Giving the sight-reading test to a larger sample size might provide different results than those seen here. The hierarchy should be further tested with samples of diverse ability levels to affirm or deny its validity.

Through their study, Alexander and Henry established three levels of difficulty for the different pitch-skill categories. Level I, the easiest category, had a success rate of 90% or higher. Level II had a success rate of 85-90% and Level III had a success rate of 85% and below. Because the pretest scores of this study were so much lower, different success rates for the three levels were established. Level I in this study referred to pitch-skill categories with a success rate above 60%. Level II had a success rate of 50-60% and Level III, still the most difficult, had a success rate below 50%. If the hierarchy remained valid across all ability levels, the success rate percentage would not matter. Only the order of difficulty would affect the hierarchy.

Looking at the specific pitch-skill categories that provided the comparisons in difficulty level, the biggest differences were in the Conjunct and Modulatory pitch-skills. Conjunct and Modulatory pitch-skills were both of Level I difficulty in the Alexander and Henry Pitch-Skill Hierarchy and thus considered to be among the easiest. Conjunct pitch-skills had a 91.42% success rate, and Modulatory had a 93% success rate. In this study's pretest, however, both Conjunct and Modulatory were of Level II difficulty. Their success rates were 59.91% and 53.23% respectively. When the pretest scores are separated by key signature, however, the results are much different. Conjunct scores in D Major were 89.21%, 46.27% in E Major, and

44.28% in E-Flat Major. The D Major pretest score is much more in line with the Alexander and Henry result.

The pretest scores for Modulatory pitches are also greatly impacted by key. Subjects performed with 69.45% accuracy in D Major, 63.89% accuracy in E Major, and with only 26.67% accuracy in E-Flat Major. The low accuracy rate for E-Flat Major lowered the overall accuracy rate for the entire pitch-skill category. The effect of key, therefore, greatly impacted the sight-reading ability of the varied ability level player. Alexander and Henry also noticed the impact of key on performance, but the difference was not as extreme as with the players of varied ability.

The differences in key signature align with string teaching methods. D Major is the first key string students learn and the primary key of their music for the first few years on their instrument. The next key signatures played in typically include G and C Major. Students in a beginning to intermediate level orchestra, even at the high school level, would not typically play in keys such as E Major and E-Flat Major on a regular basis. Both present challenges for the string player. E Major has G-sharp and D-sharp that not only leads to extended fingerings but also eliminates the playing of the G and D open string. E-Flat Major negates the use of the open A string because of its inclusion of A-flat. It also requires E-flat and B-flat, played by an extended first finger on the D and A strings that lead to an altered hand position for all instruments.

With these obstacles to standard hand position, it is easier to see why Conjunct pitch-skills were considered a more difficult category for varied ability level players. High-level players, as in the Alexander and Henry study, would be accustomed to performing scales in E and E-Flat Major and find the step-wise patterns of Conjunct pitch-skills easier than the players not accustomed to playing those scales or in those keys.

With respect to the modulatory pitches, the key of E-Flat Major provided the most difficulty in the pretest. A lowered third in E-Flat Major results in a G-flat. Though this pitch is enharmonically equivalent to an F-sharp, an easy note for all string players, the notation of a G-flat would be unfamiliar to string players unaccustomed to playing in flat key signatures. By factoring in the difficulty levels of the different key signatures, the differences between high and varied ability levels on the Alexander and Henry Pitch-Skill Hierarchy begin to make more sense.

Research Question 3: Did the performance of high school string players of varied ability, after receiving structured instruction in sight-singing, validate the Pitch-Skill Hierarchy established by Alexander and Henry? In contrast to Research Question 2, Research Question 3 compares only the experimental group's posttest with the Alexander and Henry Pitch-Skill Hierarchy. The result, however, is the same. The hierarchy is not valid with players of varied ability even after structured instruction in sight-singing.

Although the hierarchy did not apply in this case, the disparity between the Alexander and Henry scores and the posttest is much smaller than that between the Alexander and Henry scores and the pretest. For both sets of scores, the difficulty level percentages were consistent. Level I scores were performed with 90% success or higher, Level II scores were performed with 85-90% success, and Level III scores were performed with 85% or lower success. This shows that the treatment was effective in improving the sample's sight-reading ability. It also shows that the difficulty level of the different pitch-skill categories can be affected with training. It stands to reason then that continued training in specific sight-reading pitch-skills would improve all categories.

Instruction in sight-reading did cause a change in the difficulty ranking of categories from pretest to posttest. If an eight-week treatment caused a change, it would be difficult to create a hierarchy that is consistent for string players at all ability levels. The hierarchy would be constantly affected by the amount of experience the player has and their training level in sight-reading. This aligns with Luce's 1965 study that found some students were successful at difficult levels of sight-reading after failing easier levels. His study called into question the validity of a sight-reading hierarchy. In order to validate a hierarchy, whether it is that of Alexander and Henry or a newly created one, the hierarchy would need to be extensively tested with players of all ability levels.

The effect of keys on the pitch-skill categories seen in Research Question 2 also applies here. The post hoc analysis on the different sections of the test showed that students performed significantly better in D Major than in E and E-Flat Major. Again, this is probably due to the fact that the sample was not as accustomed to playing in the keys of E and E-Flat Major as the Alexander and Henry advanced players were. The Conjunct and Modulatory pitch-skill categories resulted in a Level II and III difficulty for the posttest as compared to a Level I difficulty in the Alexander and Henry study. The same issues that proved increased difficulty in the pretest would apply in the posttest.

Research Question 4: Do factors beyond the control of the experiment, such as gender, age, grade level, private lessons, theory instruction, and previous instruction in singing, have any influence on the students' instrumental sight-reading ability? For this question, the results from the student's questionnaires and their performance on the posttest were considered. Using a GLM model, it was found that certain factors did influence the students' instrumental sight-reading ability. Those factors were pretest score, age, and instrument. Gender, grade level, private lessons, theory instruction, and previous instruction in singing had no influence on the students' instrumental sight-reading ability.

Pretest score was the most significant factor influencing a student's performance on the posttest. All students showed improvement from pre- to posttest and the students with a higher performance on the pretest continued to outrank students in the posttest. A higher performance on the pretest indicated a higher level of playing ability and set that student up for continued success.

The second most significant factor influencing a student's performance was instrument. Violins and cellos significantly outperformed viola and bass players, with bass players scoring the lowest of all. This is probably due to the difficulty of music typically performed by those instruments in the orchestra classroom. Violins and cellos typically have more complicated parts and perform the melody much more often than violas and basses. Violas are often given the inner-voice instrumentation of a composition and have less movement in their line. Basses typically have the least movement in their line as their instrumentation provides the underlying harmonic function for orchestral music. At a high school level with students playing for at least four years in an orchestra setting, these orchestral roles would be well established. In a beginning string classroom this result might be different. Beginning string lessons tend to give all instruments a unison line and there would be no difference in the difficulty level of music given to each instrument. To combat this in the higher-level classrooms, violas and basses would need to be given more challenging music to perform than the typical orchestra repertoire provides.

The final significant factor was age. This again ties in to Luce's 1965 study. Luce discovered a correlation between sight-reading ability, mental quotient, and age. Older students typically outperformed younger students in sight-reading. Mental IQ was not evaluated in this study and therefore could not be calculated for its significance.

The insignificant factors of private instruction, theory training, and previous singing experience only show that the transfer of those skills to specifically string sight-reading is low. This holds true with the significance of the experimental treatment in which the singing experimental group showed no significant improvement over the instrumental control group.

Recommendations for Future Research

As this study and the McGarry and Dunlap studies showed, time spent singing in the instrumental classroom does not detract from improvement on the instrument. Further studies that extend the treatment period of vocal instruction may show that singing does cause a significant improvement to instrumental sight-reading. Additionally, conducting this study with a larger sample size would allow for more generalizations to be made on the impact of sight-singing on instrumental sight-reading.

In the use of the Alexander and Henry Sight-Reading Test, the addition of an intonation measure would increase the accuracy of the test. A more accurate assessment of intonation might have shown a larger difference between the control and experimental posttests of this study. The Alexander and Henry Sight-Reading Test also focuses solely on pitch and does not evaluate rhythm. A similar test should be created that evaluates rhythmic ability in sight-reading.

Finally, in order for a string sight-reading hierarchy to be proved valid, the Alexander and Henry Pitch-Skill Hierarchy needs to be further tested using groups of different ages and ability levels. The effect of key signature should also be considered when testing the validity of any hierarchy. Although tonal relationships are the same in every key, the nature of the string instruments allows for easier playing in specific keys. This is true for wind, brass, and percussion sight-reading but very different from vocal sight-reading. For this reason, it may be that no instrumental sight-reading hierarchy can be as definitive as the Vocal Sight-Reading Inventory.

The results of this study do provide promising statistics for string teachers. They show that sight-reading can be improved through targeted pitch-skill training. The eight-week treatment of this study was done in fifteen-minute intervals twice a week. This amount of time is minimal when compared to the amount of improvement shown in the study. The study also shows the influence of key signature on sight-reading. D Major, the most common string key, produced the most successful sight-reading results. Increasing students' exposure to other keys will only serve to heighten their ability to sight-read in those keys.

Evidence from this study shows that sight-singing in the instrumental classroom does has a positive influence on instrumental sight-reading performance. The difficulty levels assigned to certain pitch-skills is directly influenced by key signature but success rates can be improved with sight-singing instruction. Given the lack of research in string-specific studies, this study may provide an insight into teaching methods that will benefit string sight-reading performance. Further research in string sight-reading and the influence of vocal instruction on instrumental sight-reading will allow string teachers to improve their students' sight-reading performance.

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APPENDIX A

STUDENT RELEASE LETTERS

UNIVERSITY OF GEORGIA CONSENT FORM

The Effect of Vocalization on Sight-Reading in the High School String Classroom

Researcher's Statement
I am asking you to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. This form is designed to give you the information about the study so you can decide whether to be in the study or not. Please take the time to read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information. When all your questions have been answered, you can decide if you want to be in the study or not. This process is called "informed consent." A copy of this form will be given to you.

Principal Investigator:	*Dr. Mary Leglar*	*Kelly Thomas*
	University of Georgia Professor	*Kell High School Orchestra Director*
	mleglar@uga.edu	*kelly1.thomas@cobbk12.org*

Purpose of the Study
The purpose of the study is to determine the effectiveness of vocal sight-reading training on instrumental sight-reading. You are being asked to participate because you are a member of Kell's Orchestra Lasso.

Study Procedures

If you agree to participate, you will be asked to …
1. Perform a Sight-Reading Pre-test on your instrument to determine your starting sight-reading level. This will be audio-recorded to be scored at a later time.
2. Participate in 15-minute lessons during LASSO classes every Tuesday and Thursday for eight weeks from January 12th through March 20th. These lessons will go over sight-reading techniques on your instrument and may include singing. You will be randomly assigned into one of two groups and each group will receive different instructional methods.
3. Perform a Sight-Reading Posttest on your instrument to determine your ending sight-reading level. This will be audio-recorded to be scored at a later time.

Risks and discomforts
- *Your pretest and posttest performance will be audio recorded. This recording will only be heard by Ms. Thomas and two other Cobb County music teachers.*

Benefits

- *You will benefit from improved Instrumental Sight-Reading Ability that will benefit you in orchestra class, LGPE performance, and performance on your instrument outside of the classroom.*
- *Your participation will contribute to the field of music education, specifically the area of sight-reading instruction.*

Audio/Video Recording

Audio recording will be used so that your performance can be evaluated by teachers that can not be present at the time of the performance. After the performances have been scored, they will be deleted.

Privacy/Confidentiality

Everyone participating in the study will be given a number. That number will be used instead of your name to protect your privacy for all information collected. Only Ms. Thomas will keep a record of what student has been given what number and that record will be destroyed after the study has ended. Your name will never be published in connection with the study.

Researchers will not release identifiable results of the study to anyone other than individuals working on the project without your written consent unless required by law.

Taking part is voluntary

Your involvement in the study is voluntary, and you may choose not to participate or to stop at any time without penalty or loss of benefits to which you are otherwise entitled. If you decide to stop or withdraw from the study, the information/data collected from or about you up to the point of your withdrawal will be kept as part of the study and may continue to be analyzed. If you do not wish to participate in the study, you will still take part in the 15-minute lessons during LASSO class but will not record a pretest or posttest. During the pre- and posttest recording time, you will be allowed to free practice.

Participation in the study is not for a grade and will not affect your orchestra grade in any way.

If you have questions

The main researcher conducting this study is *Kelly Thomas*, a *graduate student* at the University of Georgia. Please ask any questions you have now. If you have questions later, you may contact *Ms. Thomas* at *kelly1.thomas@cobbk12.org* or at *678-494-7844.* If you have any questions or concerns regarding your rights as a research participant in this study, you may contact the Institutional Review Board (IRB) Chairperson at 706.542.3199 or irb@uga.edu.

Research Subject's Consent to Participate in Research:

To voluntarily agree to take part in this study, you must sign on the line below. Your signature below indicates that you have read or had read to you this entire consent form, and have had all of your questions answered.

_________________________ _________________________ __________
Name of Researcher Signature Date

_________________________ _________________________ __________
Name of Participant Signature Date
Please sign both copies, keep one and return one to the researcher.

Assent Script/Form for Participation in Research
The Effect of Vocalization on Sight-Reading in the High School String Classroom

We are doing a research study to find out the best way to learn how to sight-read on an instrument. We are asking you to be in the study because you are part of Orchestra Lasso. If you agree to be in the study, you will perform a Sight-Reading Pre-test on your instrument. This will be video recorded. You will participate in 15-minute lessons during LASSO classes every Tuesday and Thursday for eight weeks from January 12th through March 20th. These lessons will go over sight-reading techniques on your instrument and may include singing.
Finally, you will perform a Sight-Reading Posttest on your instrument to determine your ending sight-reading level. This will also be video recorded. Being in the study may improve your sight-reading ability. We also hope to learn something about instrumental sight-reading that will benefit other students in the future.

You do not have to say "yes" if you don't want to. No one, including your parents, will be mad at you if you say "no" now or if you change your mind later. We have also asked your parent's permission to do this. Even if your parent says "yes," you can still say "no." Remember, you can ask us to stop at any time. Your grades in school will not be affected whether you say "yes" or "no."

The only people that will watch your video recordings will be Ms. Thomas and two other Cobb County orchestra teachers. They will not be told your names. We will not use your name on any of the papers that we write about this project. We will only use a number so other people cannot tell who you are.

You can ask any questions that you have about this study. If you have a question later that you didn't think of now, you can ask Ms. Thomas in class or email her at kelly1.thomas@cobbk12.org.

Name of Child: _________________________ Parental Permission on File: ☐ Yes ☐ No**

***(For Written Assent)* Signing here means that you have read this paper or had it read to you and you are willing to be in this study. If you don't want to be in the study, don't sign.**

Signature of Child: _____________________________ Date: ____________________
(For Verbal Assent) Indicate Child's Voluntary Response to Participation: ☐ Yes ☐ No
Signature of Researcher: _____________________________ Date: ____________________

Parental Permission Form

My signature below indicates that I have have decided to allow my child to participate in the study titled "The Effect of Vocalization on Sight-Reading in the High School String Classroom" to be conducted at my child's school for eight weeks between the dates of January 12th and March 20th. I understand that the signature of the principal and classroom teacher indicates they have agreed to participate in this research project.

I understand the purpose of the research project will be to determine the effectiveness of vocal sight-reading training on instrumental sight-reading and that my child will participate in the following manner:

1. Perform a Sight-Reading Pre-test on their instrument to determine their starting sight-reading level.
2. Participate in 15-minute lessons during LASSO classes every Tuesday and Thursday from January 12th through March 20th.
3. Perform a Sight-Reading Posttest on their instrument to determine their ending sight-reading level.

Potential benefits of the study are:
Improve ability in instrumental sight-reading that will increase individual performance level on their instrument.

I agree to the following conditions with the understanding that I can withdraw my child from the study at any time should I choose to discontinue participation.

- The identity of participants will be protected. No names of participants will be used. All participants will be assigned a number for data collection and be referred to by their number only.

- Information gathered during the course of the project will become part of the data analysis and may contribute to published research reports and presentations.

- There are no foreseeable inconveniences or risks involved to my child participating in the study.

- Participation in the study is voluntary and will not affect either student grades or placement decisions (or if staff are involved-will not affect employment status or annual evaluations.) If I decide to withdraw permission after the study begins, I will notify the school of my decision.

If further information is needed regarding the research study, I can contact Kelly Thomas, Kell High School Orchestra Teacher, by email at kelly1.thomas@cobbk12.org, by phone at (678) 494-7844, or in person at Kell High School, 4770 Lee Waters Road, Marietta, GA, 30066.

Signature ____
Parent Date

Signature____
Principal Date

Signature____
Classroom Teacher Date

APPENDIX B

STUDENT QUESTIONNAIRE

Name: ______________________________ Age: ____________

Grade: ____________ Instrument: ____________

How many years have you played your instrument (including this year)? ____________

Have you ever had private lessons on your instrument? ____________
If so, how many years? ____________

Have you had any music theory training outside of orchestra class? ____________
If so, explain and give number of years:

Have you had any formal singing training? ____________
If so, explain and give number of years:

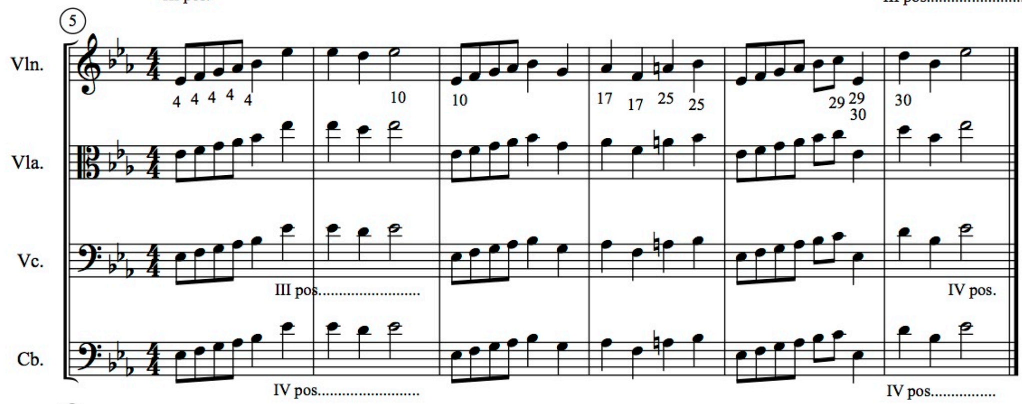
APPENDIX C

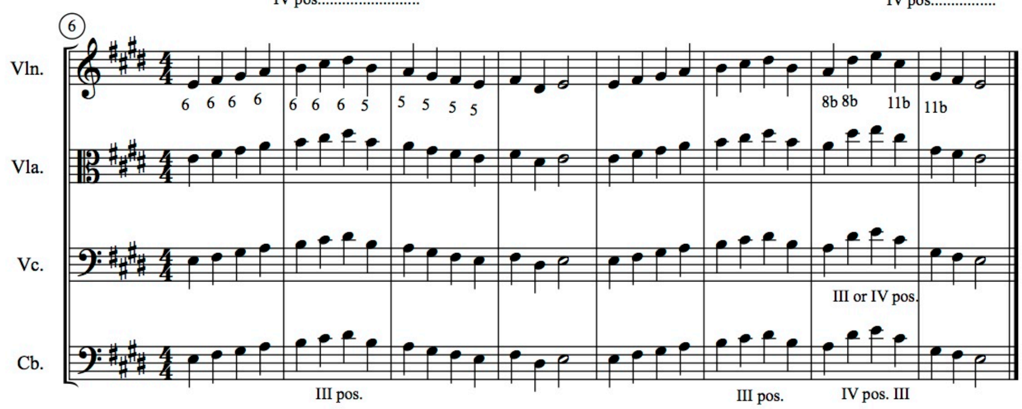
ALEXANDER AND HENRY SIGHT-READING TEST

Sight-reading #1

D Major, Eb Major, E Major


4
Vln.
Vla.
Vc.
Cb.
7 7 7 7 7 7 7 11 11 12 12 26 26 26 23 23 23 23
III pos.
III pos.........................


5
Vln.
Vla.
Vc.
Cb.
4 4 4 4 4 10 10 17 17 25 25 29 29 30 30
III pos.........................
IV pos.
IV pos.........................
IV pos...............


6
Vln.
Vla.
Vc.
Cb.
6 6 6 6 6 6 6 5 5 5 5 5 8b 8b 11b 11b
III or IV pos.
III pos.
III pos.
IV pos. III

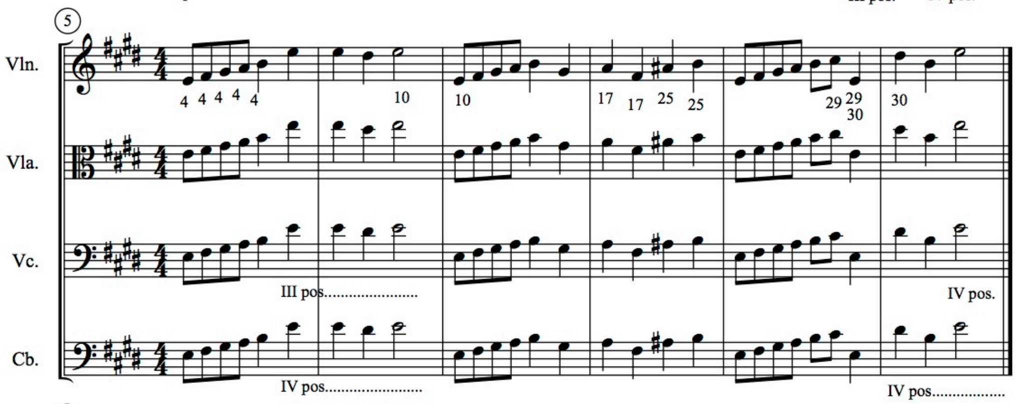
Sight-reading #2

Eb Major, E Major, D Major

Take your own tempo

Original Tune


4
Vln.
Vla.
Vc.
Cb.
IV or III pos.
III or IV pos.
IV pos.......III or II
III pos.
IV pos.


5
Vln.
Vla.
Vc.
Cb.
III pos........................
IV pos.
IV pos........................
IV pos..................


6
Vln.
Vla.
Vc.
Cb.
II or III pos.
II or III pos.
III pos.

Sight-reading #3

E Major, D Major, Eb Major

Take your own tempo

Original Tune


4
Vln.
Vla.
Vc.
Cb.
IV or III pos.
III or IV pos.
IV pos. ..IIIorII
III pos.
IV Pos.
5
Vln.
Vla.
Vc.
Cb.
III pos.......................
III pos......IV.....
6
Vln.
Vla.
III or IV pos.
Vc.
Cb.
III pos.
III pos.
IV Pos. IIorIII

APPENDIX D

SIGHT-READING TEST SCORING SHEET

Directions: Check the box for every correct pitch-skill in each melodic example.

Student	Ex. 1 D Major	1	3	19	27	31	21
Number							
	Ex. 2 E-Flat Major	2	8	15	18	22	
Sight-reading	Ex. 3 E Major	9	28	13	16	24	
Number							
1	Ex. 4 D Major	7	11	12	26	23	
	Ex. 5 E-Flat Major	4	10	17	25	29	30
	Ex. 6 E Major	6	5	8b	11b		

[redacted]							
Student	Ex. 1 E-Flat Major	1	3	19	27	31	21
Number							
	Ex. 2 E Major	2	8	15	18	22	
Sight-reading	Ex. 3 D Major	9	28	13	16	24	
Number							
2	Ex. 4 E-Flat Major	7	11	12	26	23	
	Ex. 5 E Major	4	10	17	25	29	30
	Ex. 6 D Major	6	5	14	20		
[redacted]							
Student	Ex. 1 E Major	1	3	19	27	31	21
Number							
	Ex. 2 D Major	2	8	15	18	22	
Sight-reading	Ex. 3 E-Flat Major	9	28	13	16	24	
Number							
3	Ex. 4 E Major	7	11	12	26	23	
	Ex. 5 D Major	4	10	17	25	29	30
	Ex. 6 E-Flat Major	6	5	14	20		
[redacted]							

APPENDIX E

SCRIPT FOR TEST ADMINISTRATOR

When student enters, write down their name on the Monitor Sheet. The "assigned number" column will be their student number. Give them a copy of the assigned Sight-Reading sheet (1, 2, or 3).

Announce to the student:

Today you will be performing 6 different melodies. Each line is only 8 measures long. You will have 30 seconds to study or practice each line before you record it. You may perform the melody at any speed you like but try to maintain a steady speed throughout.

Please take a minute to locate the first example for your instrument. (Pause)

You now have 30 seconds to study or practice the first line.

(Allow 30 seconds practice time using clock)

Your time is now up. I will announce your number and then you may play line one.

(Hit record and announce:)

This is Student Number _________ performing line 1.

(Student plays. Hit stop when finished.)

You now have 30 seconds to study or practice the second line.

(Allow 30 seconds practice time using clock)

Your time is now up. Please play line two following my announcement.

(Hit record and announce:)

This is Student Number ______ performing line 2.

(Student plays. Hit stop when finished.)

You now have 30 seconds to study or practice the third line.

(Allow 30 seconds practice time using clock)

Your time is now up. Please play line three following my announcement.

(Hit record and announce:)

This is Student Number ______ performing line 3.

(Student plays. Hit stop when finished.)

You now have 30 seconds to study or practice the fourth line.

(Allow 30 seconds practice time using clock)

Your time is now up. Please play line four following my announcement.

(Hit record and announce:)

This is Student Number ______ performing line 4.

(Student plays. Hit stop when finished.)

You now have 30 seconds to study or practice the fifth line.

(Allow 30 seconds practice time using clock)

Your time is now up. Please play line five following my announcement.

(Hit record and announce:)

This is Student Number ______ performing line 5.

(Student plays. Hit stop when finished.)

You now have 30 seconds to study or practice the sixth line.

(Allow 30 seconds practice time using clock)

Your time is now up. Please play line six following my announcement.

(Hit record and announce:)

This is Student Number ______ performing line 6.

(Student plays. Hit stop when finished.)

Thank you, you are finished. Please return your music to me and send in the next person.

(Collect their music and prepare for next person.)

APPENDIX F

LESSON PLAN SEQUENCE

Week 1 Instructional Foci

- Playing half steps and whole steps with intonational accuracy
- Correlation between singing in step-wise motion with playing in step-wise motion. When your voice goes up, you add a finger or go up a string. When your voice goes down you remove a finger or go down a string
- Correlation between singing half steps and playing half steps, how does finger pattern relate? (*mi* to *fa*, *ti* to *do*)
- Correlation between singing whole steps and playing whole steps, how does finger pattern relate?
- Differences in finger patterns in different keys even though scalar relationship remains the same
- Using open strings as landmarks in D Major
- Loss of open strings as landmarks in Eb Major (A String, E String) and E Major (G String, D String)

Week 1	Instrumental Control Group	Vocal Experimental Group
	• Identify Musical Roadmap • Identify Time Signature • Identify Key Signature • Identify and discuss step-wise motion, connect to scalar pattern (*drm*, *drmfs*, *drmfslt*) • Identify key and perform D Major Scale • Discuss how finger patterns (half and whole steps) stay the same though key changes • Identify key and perform Eb Major Scale • Identify key and perform E Major Scale • Sight-read examples in step-wise motion (Week 1 researcher-composed exercises and Unit 4, number 9 from Dabczynski, Meyer, and Phillips *Sight-Read It For Strings*)	• Identify Musical Roadmap • Identify Time Signature • Identify Key Signature • Identify and discuss step-wise motion, connect to scalar pattern (*drm*, *drmfs*, *drmfslt*) • Learn solfege syllables on D Major Scale • Echo-sing scalar patterns • Identify key and sing D Major scale • Perform D Major Scale • Discuss how solfege syllables and relationships stay the same even though key changes • Identify key, sing, and perform Eb Major Scale • Identify key, sing, and perform E Major Scale • Sight-sing examples in step-wise motion • Sight-read examples in step-wise motion (Week 1 researcher-composed exercises)

Week 2 Instructional Foci

- Review playing scalar pattern with intonational accuracy
- Relate arpeggio to scale- first, third, and fifth notes of scale. Also represents the notes of the tonic
- Correlation between singing arpeggio and playing arpeggio. When you skip a note or solfege syllable with your voice, you skip a note or finger of the scale.
- Differences in finger patterns in different keys even though scalar relationship remains the same
- Using open strings as landmarks in D Major, particularly for *do* to *sol* jumps
- *Do* to *sol* jumps in E-Flat Major and E Major can not use open strings but do use same hand position on different strings (modification for bass players)
- Focusing on playing in center of pitch, just as you sing in center of pitch

Week 2

Instrumental Control Group

- Review scale pattern and step-wise motion
- Introduce arpeggio for D Major, Eb Major, and E Major and perform each
- Identify skips in arpeggio as tonic jumps in sight-reading examples (*dms*, d d')
- Sight-read examples using step-wise movement and tonic jumps (Week 2 researcher-composed exercises and Unit 1, numbers 4, 7 (transposed to Eb with second ending only), 8 (transposed to Eb), and 10 (transposed to E) and Unit 7, number 2 from Dabczynski, Meyer, and Phillips *Sight-Read It For Strings*)

Vocal Experimental Group

- Review solfege syllables of scale pattern and step-wise motion
- Introduce arpeggio for D Major, Eb Major, and E Major. Sing and perform each.
- Identify skips in arpeggio as tonic jumps in sight-reading examples. Echo-sing patterns (*dms*, *d d'*)
- Sight-sing then play examples using step-wise movement and tonic jumps (Week 2 researcher-composed exercises and Unit 1, numbers 4, 7 (transposed to Eb with second ending only), 8 (transposed to Eb), and 10 (transposed to E) and Unit 7, number 2 from Dabczynski, Meyer, and Phillips *Sight-Read It For Strings*)

Week 3 Instructional Foci

- Review playing scalar pattern and arpeggio with intonational accuracy
- Dominant chord is built on fifth note of scale using *sol*, *ti*, and *re*
- Dominant seventh is build on fifth note of scale using *sol*, *ti*, *re*, and *fa*
- Correlation between singing and playing dominant triad or seventh. When you skip a note or solfege syllable with your voice, you skip a note or finger of the scale
- Intervals of a fifth (*sol* to *re)* from root to fifth of a triad use same fingering on different strings (modification for bass players)
- Differences in finger patterns in different keys even though scalar relationship remains the same
- Importance of attention to key signature, particularly *ti* (D#) of E Major to maintain half-step relationship from *ti* to *do*
- Focusing on playing in center of pitch, just as you sing in center of pitch

Week 3	**Instrumental Control Group**	**Vocal Experimental Group**
	• Review and play scale and arpeggio in D Major, Eb Major, and E Major • Build chord on Tonic (notes of arpeggio) • Build chord on Dominant • Play researcher-composed patterns practicing notes of I and V7 chord (*str*, *strf*) • Sight-read melodies using jumps of V7 (Week 3 researcher-composed and Unit 1, number 12 (transposed to Eb), Unit 4 "Mixed-Up Bach", and Unit 7, number 4 from Dabczynski, Meyer, and Phillips *Sight-Read It For Strings*)	• Review, sing, and play scale and arpeggio in D Major, Eb Major, and E Major • Build chord on Tonic (notes of arpeggio) • Build chord on Dominant • Sing and play researcher-composed patterns practicing notes of I and V7 chord (*str*, *strf*) • Sight-sing then play melodies using jumps of V7 (Week 3 researcher-composed and Unit 1, number 12 (transposed to Eb), Unit 4 "Mixed-Up Bach", and Unit 7, number 4 from Dabczynski, Meyer, and Phillips *Sight-Read It For Strings*)

Week 4 Instructional Foci

- Review playing scalar pattern, arpeggio, and dominant seventh with intonational accuracy
- Subdominant chord is built on fourth note of scale using *fa*, *la*, and *do*
- Correlation between singing and playing subdominant. When you skip a note or solfege syllable with your voice, you skip a note or finger of the scale
- Intervals of a fifth (*fa* to *do)* from root to fifth of a triad use same fingering on different strings (modification for bass players)
- Differences in finger patterns in different keys even though scalar relationship remains the same
- Using open strings as guides for subdominant in D and E Major
- Importance of attention to key signature, particularly *fa* (Ab) of E-Flat Major to maintain half-step relationship from *mi* to *fa*

Week 4	Instrumental Control Group	Vocal Experimental Group
	• Review Scalar, Tonic, and Dominant patterns by performing patterns on instrument	• Review Scalar, Tonic, and Dominant patterns by singing and performing patterns on instrument
	• Build chord on subdominant IV chord	• Build chord on subdominant IV chord
	• Play researcher-composed patterns practicing leaps between notes of dominant chord and subdominant chord (*fld*)	• Sing and play researcher-composed patterns practicing leaps between notes of dominant chord and subdominant chord (*fld*)
	• Sight-read melodies using leaps between dominant chords (Week 4 researcher-composed melodies)	• Sight-sing and play melodies using leaps between dominant chords (Week 4 researcher-composed melodies)

Week 5 Instructional Foci

- Review playing scalar pattern, arpeggio, dominant seventh, and subdominant (IV) with intonational accuracy
- Other subdominant chords can be built as well. ii chord is built on second note of scale using *re*, *fa*, and *la.* vi chord is build on sixth note of scale using *la*, *do,* and *mi*
- Correlation between singing and playing subdominant. When you skip a note or solfege syllable with your voice, you skip a note or finger of the scale
- Intervals of a fifth (*re* to *fa* or *la* to *mi)* from root to fifth of a triad use same fingering on different strings (modification for bass players)
- Correlation between vi chord and I chord: jump from *do* to *mi* is same in both. Same singing pattern will lead to same playing pattern
- Differences in finger patterns in different keys even though scalar relationship remains the same
- Using open strings as guides for subdominant in D and E Major
- Importance of attention to key signature, particularly *fa* (Ab) of E-Flat Major to maintain half-step relationship from *mi* to *fa*

Week 5	Instrumental Control Group	Vocal Experimental Group
	• Play and review researcher-composed patterns using tonic, sub-dominant, and dominant • Build chord on subdominant ii and vi chord • Play researcher-composed patterns utilizing skips and leaps between sub-dominant pitches (*fld, rfl, ldm*) • Sight-read melodies using sub-dominant skips and leaps (Week 5 researcher-composed melodies)	• Sing, play, and review researcher-composed patterns using tonic, sub-dominant, and dominant • Build chord on subdominant ii and vi chord • Sing and play researcher-composed patterns utilizing skips and leaps between sub-dominant pitches (*fld, rfl, ldm*) • Sight-sing and play melodies using sub-dominant skips and leaps (Week 5 researcher-composed melodies)

Week 6 Instructional Foci

- Review playing scalar pattern with intonational accuracy
- Discuss cadential ending as returning to tonic (*do*)
- Common cadential endings are stepwise approach to do, a jump to *do,* or *sol* to *do.*
- *Ti* to *do* is always a half step pattern. Correct singing intonation will be the smallest step in your voice, correct playing intonation will be the smallest step in your finger pattern.
- Differences in finger patterns in different keys even though scalar relationship remains the same
- Importance of attention to key signature, particularly *ti* (D#) of E Major to maintain half-step relationship from *ti* to *do*

Week 6	**Instrumental Control Group**	**Vocal Experimental Group**
	• Define cadential endings (end on *d, td, sltd, sd*) • Play researcher-composed patterns utilizing various cadential endings • Sight-read melodies using cadential endings (Week 6 researcher-composed melodies and Unit 4, numbers 3 (transposed to E Major) and 10 (transposed to D Major), Unit 5, numbers 2 and 8 (transposed to E-Flat Major), Unit 7, number 1 (transposed to E Major) from Dabczynski, Meyer, and Phillips *Sight-Read It For Strings*)	• Define cadential endings (end on *d, td, sltd, sd*) • Sing and play researcher-composed patterns utilizing various cadential endings • Sight-sing and play melodies using cadential endings (Week 6 researcher-composed melodies and Unit 4, numbers 3 (transposed to E Major) and 10 (transposed to D Major), Unit 5, numbers 2 and 8 (transposed to E-Flat Major), Unit 7, number 1 (transposed to E Major) from Dabczynski, Meyer, and Phillips *Sight-Read It For Strings*)

Week 7 Instructional Foci

- Review playing scalar pattern with intonational accuracy
- Review effect of sharps and flats on a pitch to raise or lower a pitch by a half step
- Discuss altered syllables in solfege
- Identify that there is no #*mi* or #*ti* and no b*fa or* b*do* because that half step is already part of scale
- Compare difficulty of singing chromatic scale and making sure vocal steps are small with playing chromatic scale and keeping finger positions in tight half steps
- Correct singing intonation will be the smallest step in your voice, correct playing intonation will be the smallest step in your finger pattern.
- Finger patterns for upper and lower neighbors should be with different finger not sliding same finger- relate to using different solfege syllable and not sliding/slurring voice

Week 7	Instrumental Control Group	Vocal Experimental Group
	• Define modulatory pitches (*#f and b3*) and chromatic upper and lower neighbors • Play researcher-composed patterns practicing modulatory and chromatic tones • Sight-read melodies using modulatory and chromatic tones (Week 7 researcher-composed melodies)	• Define modulatory pitches *(#f and b3*) and chromatic upper and lower neighbors • Sing and play researcher-composed patterns practicing modulatory and chromatic tones • Sight-sing and play melodies using modulatory and chromatic tones (Week 7 researcher-composed melodies)

Week 8 Instructional Foci

- Review playing scalar and chord patterns with intonational accuracy, always focusing on finding center of playing pitch to match center of singing pitch
- Use audiation to figure out what sight-reading examples will sound like and then play to match what you already identified
- Differences in finger patterns in different keys even though scalar relationship remains the same
- Use scalar relationships to help with large leaps. *Do* up to *ti* is just an octave jump minus a half step. Sing large leaps using octave landmarks to solidify correct sound of intervallic jumps
- Discuss sizes of large leaps and relate to finger patterns. Sixth= fifth (string crossing) plus one note, Seventh= fifth (string crossing) plus two notes and the reverse when going down.

Week 8	Instrumental Control Group	Vocal Experimental Group
	• Define large leaps (*d l, d t, r t)* • Play researcher-composed patterns practicing large leaps • Review and play scale, arpeggio, thirds pattern, and I-IV-V7-I progression for D Major, E Major, and E-Flat Major • Sight-read melodies using large leaps and utilizing various pitch-skill combinations (Week 8 researcher-composed melodies)	• Define large leaps (*d l, d t, r t)* • Sing and play researcher-composed patterns practicing large leaps • Review, sing, and play scale, arpeggio, thirds pattern, and I-IV-V7-I progression for D Major, E Major, and E-Flat Major • Sight-sing and play melodies using large leaps and utilizing various pitch-skill combinations (Week 8 researcher-composed melodies)

APPENDIX G

RESEARCHER-COMPOSED MUSICAL EXAMPLES

Week 1- Violin

Week 1 Viola

Week 1 Cello and Bass

Week 2 Violin

Week 2 Viola


D Major Scale and Arpeggio
E Major Scale and Arpeggio
E Flat Major Scale and Arpeggio
Melody 1
Melody 2
Melody 3

Week 2 Cello and Bass

Week 3 Violin

Week 3 Viola


D Major
I
V7
I
V7
I
7
E♭ Major
I
V7
I
I
V7
13
I
V7
I
I
V7
19
E Major
I
I
V7
I
24
V7
I
I
V7
I
30
Melody 1
34

Week 3 Cello and Bass

Week 4 Violin


44
Melody 3
2
51
54


D Major
I
IV
V7
I
I IV V7 I Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol Do
6
E♭ Major
I
IV
V7
I
I IV V7 I Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol Do
11
E Major
I
IV
V7
I
Melody 1
I IV V7 I Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol Do
17
24
Melody 2
29
Melody 3
34
37

Week 4 Viola


D Major I and V7 Skips
I
V7
I
7
V7 Leaps
12
E Major I and V7 Skips
I
V7
I
18
V7 Leaps
23
E♭ Major I and V7 Skips
I
V7
I
29
V7 Leaps
34
Melody 1
39
Melody 2
44
Melody 3
2
51
54


D Major
I IV V7 I
I IV V7 I Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol Do
6
E♭ Major
I IV V7 I
I IV V7 I Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol Do
11
E Major
I IV V7 I
I IV V7 I Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol Do
16
Melody 1
23
Melody 2
28
Melody 3
33
37

Week 4 Cello and Bass


D Major
I
IV
V7
I
I IV V7 I Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol Do
6
E♭ Major
I
IV
V7
I
I IV V7 I Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol Do
11
E Major
I
IV
V7
I
I IV V7 I Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol Do
16
Melody 1
23
Melody 2
28
Melody 3
33
37

Week 5 Violin

Subdominant ii and vi

Week 5 Viola


I IV V7 I Sub-Dominant (IV) Lea
Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol Fa Re Do
6
12
I IV V7
Do Mi Sol Mi Do Fa La Fa Ti Re Fa Sol
18
I Sub-Dominant (IV) Leaps
Fa Re Do
24
I
Do Mi Sol Mi
30
IV V7 I Sub-Dominant (IV) Leaps
Do Fa La Fa Ti Re Fa Sol Fa Re Do
35
41
Melody 1
47
Melody 2
53
Melody 3
60
64

Subdominant ii and vi


43
Melody 2
2
49
54
58

Week 5 Cello and Bass

Subdominant ii and vi

Week 6 Violin

Week 6 Viola


♩= 120
Do Ti Do
Do Ti La Ti Do
Do Ti La Sol La Ti Do
Sol Do
La Ti Do
6
Ti Do
Do
Do Ti Do
Do Ti La Ti Do
Do Ti La Sol La Ti Do
11
Sol Do
La Ti Do
Ti Do
Do
Do Ti Do
Do Ti La Ti Do
17
Do Ti La Sol La Ti Do
Sol Do
La Ti Do
Ti Do
Do
Melody 1
23
Melody 2
28
33
Melody 3

Week 6 Cello and Bass

Week 7 Violin


♩=120 D Major
Upper Neighbors
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Re
6
Lower Neighbors
Mi Fa Sol La Ti Do Do Re
10
Melody 1
Mi Fa Sol La Ti Do
14
E♭ Major
Do Re Mi Fa Sol La Ti Do
19
Upper Neighbors
Ti La Sol Fa Mi Re Do Do Re Mi Fa Sol La
24
Lower Neighbors
Ti Do Do Re Mi Fa Sol La Ti Do
29
Melody 2


34
E Major
2
Do Re Mi Fa Sol La Ti Do
39
Upper Neighbors
Ti La Sol Fa Mi Re Do Do Re Mi Fa Sol La
44
Lower Neighbors
Ti Do Do Re Mi Fa Sol La
48
Melody 3
Ti Do
52

Week 7 Viola

♩=120 D Major
Do Mi Sol Mi Re Fi Sol Fi Sol Re Ti Re Do
Do Re Me Re Do
7
E♭ Major
Do Mi Sol Mi Re Fi Sol Fi Sol Re Ti Re Do
Do Re Me Re Do
13
E Major
Do Mi Sol Mi Re Fi Sol Fi Sol Re Ti Re Do
Do Re Me Re Do
19
24
29
34
38


♩=120 D Major
Upper Neighbors
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Re
6
Lower Neighbors
Mi Fa Sol La Ti Do Do Re
10
Melody 1
Mi Fa Sol La Ti Do
14
E♭ Major
Do Re Mi Fa Sol La Ti Do
19
Upper Neighbors
Ti La Sol Fa Mi Re Do Do Re Mi Fa Sol La
24
Lower Neighbors
Ti Do Do Re Mi Fa Sol La Ti Do
29
Melody 2


34
E Major
2
Do Re Mi Fa Sol La Ti Do
39
Upper Neighbors
Ti La Sol Fa Mi Re Do Do Re Mi Fa Sol La
44
Lower Neighbors
Ti Do Do Re Mi Fa Sol La
48
Melody 3
Ti Do
52

Week 7 Cello and Bass


♩=120 D Major
Upper Neighbors
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Re
6
Lower Neighbors
Mi Fa Sol La Ti Do Do Re
10
Melody 1
Mi Fa Sol La Ti Do
14
E♭ Major
Do Re Mi Fa Sol La Ti Do
19
Upper Neighbors
Ti La Sol Fa Mi Re Do Do Re Mi Fa Sol La
24
Lower Neighbors
Ti Do Do Re Mi Fa Sol La Ti Do
29
Melody 2


34
E Major
2
Do Re Mi Fa Sol La Ti Do
39
Upper Neighbors
Ti La Sol Fa Mi Re Do Do Re Mi Fa Sol La
44
Lower Neighbors
Ti Do Do Re Mi Fa Sol La
48
Melody 3
Ti Do
52

Week 8 Violin


♩=120 Scale
Arpeggio
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Mi Sol Do
6
Thirds
Sol Mi Do Do Mi Re Fa Mi Sol Fa La Sol Ti La Do Ti Do Do La Ti Sol La Fa Sol Mi
10
I IV V7 I
Fa Re Mi Do Re Ti Do Do Mi Sol Mi Do Fa La Fa Sol Ti Sol Fa Re Mi Do
15
Melody 1
19
Scale
Arpeggio
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Mi Sol Do Sol Mi Do
25
Thirds
Do Mi Re Fa Mi Sol Fa La Sol Ti La Do Ti Do Do La Ti Sol La Fa Sol Mi Fa Re Mi Do Re Ti Do
29
I IV V7 I
Melody 2
Do Mi Sol Mi Do Fa La Fa Sol Ti Sol Fa Re Mi Do
35


41
Scale
Arpeggio
2
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Mi Sol Do
46
Thirds
Sol Mi Do Do Mi Re Fa Mi Sol Fa La Sol Ti La Do Ti Do Do La Ti Sol La Fa Sol Mi
50
I
IV
V7
I
Fa Re Mi Do Re Ti Do Do Mi Sol Mi Do Fa La Fa Sol Ti Sol Fa Re Mi Do
55
Melody 3
59

Week 8 Viola


♩=120
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Re Do Mi
6
Do Fa Do Sol Do La Do Ti Re Ti Do Do Re Mi Fa Sol La Ti Do
11
Ti La Sol Fa Mi Re Do Do Re Do Mi Do Fa Do Sol Do La Do Ti
16
Re Ti Do Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do
21
Melody 1
Do Re Do Mi Do Fa Do Sol Do La Do Ti Re Ti Do
26
30
33


♩=120 Scale
Arpeggio
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Mi Sol Do
6
Thirds
Sol Mi Do Do Mi Re Fa Mi Sol Fa La Sol Ti La Do Ti Do Do La Ti Sol La Fa Sol Mi
10
I
IV
V7
I
Fa Re Mi Do Re Ti Do Do Mi Sol Mi Do Fa La Fa Sol Ti Sol Fa Re Mi Do
15
Melody 1
19
Scale
Arpeggio
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Mi Sol Do Sol Mi Do
25
Thirds
Do Mi Re Fa Mi Sol Fa La Sol Ti La Do Ti Do Do La Ti Sol La Fa Sol Mi Fa Re Mi Do Re Ti Do
29
I
IV
V7
I
Melody 2
Do Mi Sol Mi Do Fa La Fa Sol Ti Sol Fa Re Mi Do
35


41
Scale
Arpeggio
2
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Mi Sol Do
46
Thirds
Sol Mi Do Do Mi Re Fa Mi Sol Fa La Sol Ti La Do Ti Do Do La Ti Sol La Fa Sol Mi
50
I
IV
V7
I
Fa Re Mi Do Re Ti Do Do Mi Sol Mi Do Fa La Fa Sol Ti Sol Fa Re Mi Do
55
Melody 3
59

Week 8 Cello and Bass


♩= 120 Scale
Arpeggio
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Mi Sol Do
6
Thirds
Sol Mi Do Do Mi Re Fa Mi Sol Fa La Sol Ti La Do Ti Do Do La Ti Sol La Fa Sol Mi
10
I IV V7 I
Fa Re Mi Do Re Ti Do Do Mi Sol Mi Do Fa La Fa Sol Ti Sol Fa Re Mi Do
15
Melody 1
19
Scale
Arpeggio
Do Re Mi Fa Sol La Ti Do Ti La Sol Fa Mi Re Do Do Mi Sol Do Sol Mi Do
25
Thirds
Do Mi Re Fa Mi Sol Fa La Sol Ti La Do Ti Do Do La Ti Sol La Fa Sol Mi Fa Re Mi Do Re Ti Do
29
I IV V7 I
Melody 2
Do Mi Sol Mi Do Fa La Fa Sol Ti Sol Fa Re Mi Do
35