

**THE EFFECTS OF AUDIATION ON THE MELODIC ERROR DETECTION
ABILITIES OF FOURTH AND FIFTH GRADE BAND STUDENTS**

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ABSTRACT OF THE DISSERTATION

The Effects of Audiation on the Melodic Error Detection Abilities of Fourth and Fifth Grade Band Students.

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The purpose of this study was to compare the use of vocalization methods on students' ability to detect tonal errors. More specifically, two approaches to teaching instrumental music were investigated, the use of a singing-based approach and use of an audiation-based approach. A secondary purpose of the study was to investigate if level of music aptitude affects error detection ability.

Subjects consisted of 108 band students in fourth or fifth grade. Prior to the treatment period, subjects were administered the *Intermediate Measures of Music Audiation (IMMA)* to measure tonal musical aptitude and a researcher designed questionnaire to measure prior musical experience. Students were grouped homogenously by instrument and grade level. Each group was randomly assigned to either 1) a singing-based instruction group, 2) an audiation-based instruction group or 3) a control group. During the eight-week treatment period, subjects were taught songs by rote. The singing-based group became familiar with the songs by learning to audiate and sing them through a procedure outlined in the *Jump Right In: Instrumental Series* band method book. Students in the audiation-based group became familiar with the songs using the same procedure omitting the singing step. Students in the control group did not receive instruction that included audiation or singing. At the end of the treatment period, students were administered the *Error Detection Test*.

Data was analyzed through a Nested ANCOVA using tonal aptitude as a covariate. No significant results were found regarding treatment and the ability to detect errors at the $p < .05$

level. However, significance was found ($p = .021$) in regards to level of tonal aptitude and ability to detect errors favoring subject's with high tonal aptitude.

Results of the study indicate that instruction which includes audiation is not an effective technique in developing error detection skills of elementary band students. It was also concluded that high tonal aptitude students were significantly better at detecting errors over medium and low tonal aptitude students.

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CHAPTER ONE

Introduction

Singing has always been integral to all aspects of music education including instrumental music. Standard number one of the National Standards for Music Education states that students should be able to “sing alone and with others, a varied repertoire of music” (MENC, 1994, p. 13). Long before the standards were written, incorporating singing and vocalization techniques into instrumental lessons was common practice. Lowell Mason, who is regarded as the father of American music education, wrote about the importance of how teachers should include singing in instrumental music instruction (Erwin, Edwards, Kerchner & Knight, 2003, p. 180). Mason took the ideas of Swiss educator Johann Pestalozzi, who advocated a whole–part–whole approach and adapted his ideology to music. The first listed principle in an outline he presented at the American Institute of Instruction meeting in Boston in 1830 was “to teach sounds before signs and to make the children learn to sing before he learns the written notes or their names” (Leonard & House, 1959, p. 52).

The positive effects of singing and use of vocalization in instrumental music lessons is also well documented in current educational research. Elliott (1974) and Smith (1984) both investigated the use of vocalization on intonation of band students and found significant results favoring the inclusion of vocalization. Davis (1981) and MacKnight (1975) found significant results favoring vocalization on beginning instrumentalists in the area of performance achievement. More specifically, Gamble (1989) examined the effects of tonal pattern activities on beginning clarinet players and found that the use of tonal pattern training significantly improved not only performance achievement but also audiation skills. Lee (1996) found that including vocalization significantly increased the articulation and phrasing abilities of

elementary instrumental students. Bloedel-Berry (1996) reported similar findings in her study involving singing instruction with beginning band students and found significant results in the improvement of musical expression. Grutzmacher (1987) found that vocalization activities increased the sight reading achievement of beginning band students and that the tonal pattern training in her study increased the aural discrimination abilities of students between major and minor tonalities. Bernhard (2004) also reported that the students in his study demonstrated increases in ear playing without sacrificing sight reading achievement although it was not statistically better than the control group.

Even with several published studies, teachers of instrumental music still fail to include vocal activities as part of their instruction (Wolbers, 2002). In a study that examined the use of vocalization in high school band rehearsals, Burton (1986) sent a questionnaire to band directors and reported that vocalization was not frequently employed in band rehearsals. The lack of singing pedagogy that teachers currently use in beginning instrumental lessons differs from past practices. Leonard and House (1959) suggest that this may be because as music instruction became more present in schools, music literacy was emphasized through note reading. Ironically, the new focus on improving music literacy through music notation may have led to the decline of using vocalization in instrumental instruction.

More current explanations for the lack of vocalization in instrumental lessons have been discussed by many authors and researchers. Adding to possible reasons for teachers not including vocalization techniques Schleuter (1997) states:

Most instrumental music teachers teach the way they were taught as children; they seldom examine or question traditional methods and techniques of instruction with regard to current theories and knowledge about music learning. Good, bad and inefficient methods and techniques of teaching music persist through unquestioned adherence to tradition. (p. 20)

Dalby (1999) concurs and states “...instrumental teachers may be hesitant to ‘swim against the tide’ of their profession by adopting values and methods that differ significantly from their colleagues” (p. 22).

The lack of singing in the instrumental classroom may also be due to higher education and the coursework music education majors are required to take while in college. Leenman (1997) suggested that instrumental teachers may not include vocalization techniques in lessons because of the specific coursework and syllabus of their college program. Leenman explains that most music education programs offer a vocal track and an instrumental track; both have courses that are tailored to that specialization. Many music education students in the instrumental track have very little, if any, courses concerning the voice. As a result, teachers may be hesitant to sing in front of others because they are self conscious about the quality of their singing voice. Apfelstadt (1989) supports this concept, “Where a fear of singing exists, there is the danger that teachers will not use singing in their classrooms” (p. 26).

Robinson (1996) lists three reasons for instrumental music teachers not including vocalization as part of their pedagogy; 1) lack of time, 2) lack of their own ability to sing and 3) fear of negative student reaction and ultimate attrition. As Robinson suggests, the lack of vocalization techniques may not only be due to resistance from teachers but students as well.

Compounding to the problem of teachers not being comfortable using the voice in instrumental instruction, there are also many reasons that elementary students may be resistant to singing. Siebenaler (2008) reported that the attitudes of fifth grade boys and girls declined toward school music class, which is when many school band and orchestra programs start. During this period of adolescence, students maybe become more prone to influence from outside factors. Singing in small group situations like beginning instrumental lessons may increase self-

consciousness and as a result, increase resistance to singing. Boys can be especially resistant to singing; a study by Castelli (1986) reported that American boys thought singing was less of a masculine activity and more of a feminine one. Phillips and Aitchison (1998) administered a survey and found that students who do not like to sing may respond negatively to all types of singing instruction.

Lastly, the lack of vocalization in instrumental classes may be due to the popular band and orchestra methods used today. Grunow (2005) states “Obviously, beginning instrumental music teachers should give high priority to appropriate methods, techniques, and materials” (p. 189). However, not many of today’s popular band and orchestra method books incorporate the use of vocalization. A study by Kretchmer (1998) reviewed ten current and popular instrumental method books used by music teachers in Washington and California and found that only four of them incorporated the use of singing or vocalization. Of these four method books, none of the vocalization activities were reported as commonly used. McPherson supports the findings of Kretchmer and states:

An investigation of the most popular band methods used throughout the world shows that typical instrumental instruction is characterized by visually oriented re-creative tasks, and an almost total reliance on note reading. Yet, despite the reliance on notation evident in these and other beginning instrumental tutors, some contemporary authors advocate techniques commonly associated with classroom music instruction. These authors recommend the use of rote teaching methods, playing by ear, improvisation, and other forms of aural performance. (1993, p. 11)

Also like Kretchmer’s study, Brittin and Sheldon (2004) surveyed popular band method books in use today but also compared them to the *Universal Teacher* (Maddy & Giddings, 1923). The *Universal Teacher* was the first published band method book in the United States that facilitated heterogeneous groupings of instruments. In this study, Brittin and Sheldon wrote about the lack of singing and vocalization activities in the popular methods used today.

The inclusion of lyrics in many *Universal Teacher* melodies gives a clue to what may have been a primary teaching strategy. Presumably students would have been asked to sing the songs before playing, suggesting a reliance on playing by ear. When considering the number of melodies most likely familiar to a youngster in 1923, it appears the method may have relied much more heavily on students' familiarity with the selections. This would facilitate home practice and perhaps make possible this seemingly accelerated teaching pace. (p. 53)

Even with current research and past practice, publishers of many popular band methods are not incorporating the use of singing or other vocalization activities in method books, which may be a contributing factor to teachers not including the activities in their lessons. There are some current method books that do incorporate the use of singing as part of the methodology, these include *Do It, Play in Band* (Froseth, 1997) and *Jump Right in: The Instrumental Series* (Grunow, Gordon & Azzara, 2001). Both of these method books include various singing activities. For example, students are taught to sing songs before they are expected to perform them on an instrument. The *Jump Right In* book also relies heavily on the use of audiation, which is a term developed by Gordon (1997). Gordon defines audiation as "Hearing and comprehending in one's mind the sound of music that is not physically present" (p. 361). In the *Jump Right In* book series, students are taught to audiate songs as well as sing them before performing on an instrument. There have been very few studies that have explored the use of alternates to vocalization techniques like audiation. In an article by Wilson and DeJournett (2006), humming is described as a possible place to start encouraging vocalization techniques with band students who may be resistant to singing. Bennett (1994) conducted a study investigating the use of humming as a way of improving intonation with high school band students. However, the use of humming was found to be not significant. To this researcher's knowledge, there have been no studies conducted that examine the use of audiation as an alternative vocalization technique to singing.

As previously written, the effect of vocalization has been examined on a variety of musical concepts in instrumental music. Researchers have examined the effects on students' intonation, performance achievement, audiation skills, articulation and phrasing abilities, musical expression, sight reading achievement and ear playing ability. Few examine the use of vocalization on students' ability to detect performance errors.

Error detection in instrumental music is an invaluable part of the learning experience (Sheldon, 2004). Students are expected to know when they make a mistake and self-correct while at home away from the teacher. Schleuter however, believes that traditional instruction does not nurture this skill. Schleuter (1997) states "Most traditional instruction of beginning instrumentalists excludes a developmental sequence for establishing a sense of tonality" (p. 41). He further explains:

Traditionally, emphasis is placed on technical skill with the instruments, rhythm-reading skills, and association of fingerings with notation. Instrumentalists are often preoccupied with reading pitch notation as fingering cues at beginning stages of learning. Reading from note to note with appropriate fingerings does not efficiently develop a sense of tonality. Instrumental students are allowed and encouraged to use instruments as tonal crutches by primarily associating notation with correct fingerings – not the correct sound. As a result, there are scores of instrumental performers who "can't perform without their music" and in fact can't perform *with* their music. Students need directed training to develop a sense of tonality that will in turn aid their instrumental performance. (p. 41)

Thornton (2008) strengthens this statement and questions if error detection is beyond the ability of elementary instrumental students:

With the myriad of possibilities of musical information requiring attention during performance, playing the correct pitches would be considered one of the most basic. Being able to detect an incorrect pitch and correct the error would be fundamental to improvement of performance and independence on the part of the musician. Whether melodic error detection during performance is within the capabilities of the beginning instrumental student is not yet known. (p. 10)

There are few studies that explore singing and how it affects error detection. Additionally, there is a lack of research that explores if audiation is an effective technique in improving error detection skills of elementary instrumental students.

Summary

Singing is integral to all parts of music education. In regards to instrumental lessons, it can become an invaluable tool for improving many aspects of music. These include intonation, articulation, phrasing, expression, sight reading, ear playing ability, performance achievement and audiation performance. However, a review of the literature indicates that both students and teachers may be resistant to singing or vocalization activities in the instrumental classroom. Not many studies exist that examine the use of alternate vocalization techniques and how it can affect students' ability to detect errors, therefore there is a need for studies in this area.

Statement of Purpose

The purpose of this study was to examine the use of audiation on the melodic error detection ability of beginning instrumentalists. Instruction using audiation techniques was used as an alternative to singing in the instrumental classroom. The use of audiation in lieu of singing could provide the valuable process of vocalization but eliminate the resistance some teachers and students feel toward the physical act of singing.

Research Questions

The study attempted to answer the following research questions:

1. Will the melodic error detection abilities of beginning instrumentalists be affected by instruction that includes audiation techniques?
2. Is there a significant difference between audiation and singing in the ability of beginning instrumentalists to detect melodic errors?

A secondary question of the study included:

1. Does level of music aptitude relate to students' ability to detect melodic errors?

Hypotheses

The study was based on an experimental design with quantitative data to compare the error detection ability of students who received audiation instruction and students who received singing instruction. The use of a control group was also employed.

The null hypothesis assumes that the researcher will find no significant difference in the abilities of students (Moore & McCabe, 2003). The null hypotheses for the study was as follows:

Ho#1 – Melodic error detection ability will not be affected by instruction that includes audiation techniques.

Ho#2 – There will be no difference in the melodic error detection abilities of students among treatment groups.

Ho#3 – There will be no difference between melodic error detection ability and level of music aptitude.

Assumptions

The following assumptions were made prior to the start of the study:

1. It was assumed that students will be honest and cooperative throughout the treatment period.
2. It was assumed that students' music aptitude level will be evenly distributed among the treatment and control groups.
3. It was assumed that students with prior experience in music will identify themselves on the background questionnaire.

Limitations

Limitations of the study could have been related to the length of the eight-week treatment period. Subjects' prior music experience or a skewed distribution of musical aptitude may have also been a factor that contaminated results. Finally, one of the treatments was based on

audiation which cannot be seen or heard. Multiple techniques were employed in an attempt to ensure audiation was taking place but there was no way to objectively measure it. Although subjects were taught to audiate using the techniques, they may not have fully understood how to use it during the treatment period.

Definition of Terms

- 1) Audiation - Hearing and comprehending in one's mind the sound of music that is not physically present.
- 2) Aural Discrimination – The ability to tell if two musical patterns are the same or different.
- 3) Ear Playing Ability – The ability to perform a piece of music on an instrument after hearing it.
- 4) Error Detection – The ability to identify mistakes in a musical performance.
- 5) Improvisation - The spontaneous use of tonal, rhythmic and harmonic patterns with restrictions.
- 6) Intonation – The act of singing or playing an instrument in tune. Thus we speak of a singer or instrumentalist's 'intonation' as being good or bad.
- 7) Performance Achievement – A measure of one's ability to play an instrument.
- 8) Rote Teaching – Information that students learn as a result of repeating what they are told or by repeating what has been performed for them, usually by a teacher.
- 9) Sight Reading Achievement – The ability to perform a piece of music without having time to prepare.
- 10) Tonal Pattern – Two, three, four or five pitches in a given tonality that are audiated sequentially and form a whole.
- 11) Vocalization – Creating music through the use of the voice.

CHAPTER TWO

Review of the Literature

The purpose of this chapter is to review the past literature concerning the singing voice and its pedagogical use in instrumental music education. The review is divided into three main parts: 1) a review of studies relating to the use of the singing voice in instrumental music education, 2) a review of studies relating to student resistance to singing, and a 3) review of studies relating to error detection in instrumental music. Additionally, audiation is one of the variables in the study and foundational information is also described.

Introduction

There have been different trends and approaches in teaching instrumental music to children. One of the most popular trends today is teaching young instrumentalists to read music notation from the very first lesson. Perhaps this is because many of the popular band methods in use today are based on this type of instruction, which is referred to as the “traditional” or notation-based approach. Examples of notation-based approaches are band methods *Standard of Excellence* (Pearson, 1993), *Accent on Achievement* (O’Reilly & Williams, 1997) and Ed Sueta’s *Band Method* (1974). In each of these notation-based approaches notes and rhythms are introduced one at a time. One of the problems with this kind of approach is that the teaching of notation and technical skills are taught at the expense of developing students’ aural skills. As a result, the reading and counting of notation mask aural music abilities, some of which are innate. Students taught with this kind of approach learn to decode music instead of comprehending it. In essence, students become “button pushers” and associate the notation with the correct fingering. The aural part of their music learning is shut off and not developed.

Contrasting the traditional notation-based approach is the aural approach to teaching instrumental music in which teaching music notation is delayed. There are band method books available that incorporate an aural approach into their design. These methods differ from traditional band method books because music notation is not taught until students are given ample aural experiences with their instrument. Students learn to play by ear, discriminate patterns and improvise simple melodies *before* they are taught to read notation. Examples of aural based method books are *The Individualized Instructor* (Froseth, 1970), *Do it! Play in Band* (Froseth, 1997) and *Jump Right In: the instrumental series* (Grunow, Gordon & Azzara, 2001). Many of these non-notation based band methods focus on building students' musicianship or aural skills as well as the technical skills needed to play an instrument.

Singing and chanting are often teaching tools used heavily in these methods. It is through singing and chanting that students develop musicianship which includes the concepts of phrasing, tonality, intonation, rhythm, meter and the ability to detect errors.

Singing in instrumental music education

There are many studies that investigate the effects of using the singing voice in the instrumental music classroom. The positive effects that the use of the singing voice yields includes the improvement of intonation, sight reading achievement, pitch accuracy, articulation and phrasing, music aptitude scores and performance achievement. Many of the studies refer to singing activities as vocalization. Vocalization is defined as "to sing" by Merriam-Webster's Dictionary (2006). The terms vocalization and singing will be used interchangeably to describe activities that involve the melodic use of the voice.

The effect that singing or vocalization has on instrumental music education has been well documented. For example, Elliott (1974) sought to examine the effect that vocalization has on

beginning band students' sense of pitch. Subjects for the study were beginning band students and were separated into a control and experimental groups. The control group received traditional instruction that did not include the use of vocalization. Subjects in the experimental group received identical instruction to the control group except with the addition of vocalization training during lessons. When comparing the control and experimental group's post-test scores, Elliott reported significant results ($p < .05$) favoring the experimental group. The researcher concluded that the use of vocalization during band classes improves the sense of pitch of beginning band students.

A study by Coveyduck (1998) compared the effect of singing on the intonation of beginning instrumental students. Similar to the Elliott study, Coveyduck designated control and experimental groups. The control group received traditional instruction that did not include the use of singing while the experimental group received similar instruction but with the addition of singing activities. Subjects in Coveyduck's study were given the *Musical Aptitude Profile* and a background questionnaire as pre-tests. The post-test was the playing performance of an etude on subjects' instruments, which was recorded and evaluated by judges. Coveyduck found significant results ($p = .040$) favoring the experimental group which included the use of singing. However, the background questionnaire identified students who had prior voice experience and once they were eliminated from the study, the findings were no longer significant.

Research by Smith (1984) also investigated the relationship vocalization had on intonation, however subjects in his study were college students. The purpose of the study was to investigate the effects vocalization had on the intonation of college students' instrumental performances. Subjects for the study included college students who played a wind instrument. Subjects were divided into two groups, a control group which performed exercises on their

instruments without the use of the singing voice and an experimental group that vocalized the performance exercises before performing on their instrument. Contrary to the findings of Elliott, no significant differences between groups were found. However, Smith did report significant differences ($p < .05$) in intonation between brass and woodwind students. The cent deviation of woodwind players decreased slightly while the cent deviation of brass players greatly increased.

Jones (2003) conducted a recent study involving the use of the voice to improve intonation. During the study, subjects used vocalization for varying lengths of time as part of the tune up process. Jones concluded that the use of vocalization significantly ($p < .05$) improved the subjects' ability to discriminate the difference between playing sharp or flat.

While the Elliott and Jones studies were the only one with significant results, subjects in Coveyduck's study responded favorably to the treatment indicating that the use of vocalization has a positive effect on the intonation of beginning band students. It is important to note that although Smith did not find significance among treatment groups, he did find that vocalization had positive results on woodwind students.

Sight reading is considered a valuable skill in music. Colwell and Goolsby (1992) state "Sight reading is the means by which all the learned skills, aural, technical, and cognitive, are used" (p. 95). Researchers have found that the use of vocalization and singing can have a positive result on a student's ability to sight read.

Grutzmacher (1987) examined the use of the voice on sight reading ability. More specifically, Grutzmacher used solmization and tonal pattern training and examined its effect on the sight reading achievement and aural recognition of beginning band students. Subjects were divided into control and experimental groups. The control group was given traditional instruction without the use of the singing voice. The instruction for the experimental group consisted of

tonal patterns taught through harmonization and vocalization. Grutzmacher reported significant results favoring the experimental group in melodic sight reading achievement ($p < .0001$) and aural identification of major and minor tonalities ($p < .001$).

MacKnight (1975) examined the use of tonal pattern training on the performance achievement of beginning instrumentalists which included sight reading ability. Subjects in the study consisted of 85 fourth grade band students from three elementary schools. One of the schools was assigned as the experimental group and received treatment while the other two schools were designated as control groups. Prior to the 32-week study, the researcher administered the *Musical Aptitude Profile* (Gordon, 1965). Students in the control group were taught in a traditional manner using the *Breeze Easy* (Kinyon, 1959) method book. Subjects in this group were not given any aural instruction but instead taught using the fingering illustrations in the book. Subjects in the experimental group were taught the same pitches, rhythms and concepts as the control group but without the use of notation. The experimental group was also given tonal pattern instruction using solfege. At the conclusion of the treatment period, subjects were administered the *Watkins-Farnum Performance Scale* (1954), the *Music Achievement Test* by Colwell (1967) and a student questionnaire. MacKnight reported that the experimental group scored significantly higher on both the *Watkins-Farnum Performance Scale* ($p < .05$) and the *Music Achievement Test* ($p < .05$), indicating that the use of vocalization improves both sight reading skill and aural discrimination.

Bernhard (2003) investigated the effects of tonal training on the melodic ear playing ability and sight reading achievement of beginning wind instrumentalists. Experimental in design, subjects in Bernhard's study were divided into two control groups and two experimental groups. The control groups received traditional instruction without the use of the singing voice

and the experimental groups received similar instruction to the control group but with the addition of vocalization and solmization training. After a performance test, Bernhard concluded that singing improved melodic ear playing achievement of beginning band students ($p < .001$). However, contrasting the Grutzmacher and MacKnight studies, Bernhard did not find significant results among treatment groups in sight reading ability. The researcher suggested that the use of vocalization improves melodic ear playing ability without negatively affecting sight reading performance. In other words, the use of vocalization during beginning instrumental instruction does not take away from a students' ability to sight read.

Unlike Macknight's study which concluded that vocalization improved the sight reading ability of subjects, Davis (1981) reported mixed results. The purpose of Davis's study was to examine the effects of singing activities on a student's instrumental performance, melodic tonal imagery, self-evaluation of instrumental performance and attitude. The researcher also sought to examine how students' self-evaluation of practice affected the same factors. Subjects included 93 fifth and sixth grade band students who were randomly placed into experimental or control groups. The control group was taught with a traditional approach that did not include singing activities. One experimental group was taught using singing activities, a second experimental group was given instruction on how to self-evaluate while practicing and the third experimental group was taught using both singing activities and self-evaluation of practice. Davis found significant results ($p < .05$) in performance achievement of fifth grade students favoring the experimental group. However, the result was different for sixth grade students where the conditions in both the experimental and control groups were found to be equally as effective in performance achievement.

Results differed for Krubsack (2006) who also investigated the role singing has on performance achievement. The purpose of the study was to investigate the effects of singing as a method to improve performance achievement in high school wind instrumentalists. Krubsack used members of two intact school bands from different schools as subjects for the study. Prior to the study, all subjects performed and recorded an etude as a pre-test measure. During treatment, subjects in Band A received singing instruction while subjects in Band B did not. At the end of the five-week treatment period, subjects performed and recorded the same etude. The researcher repeated the experiment for an additional five weeks but reversed the treatment so Band B received singing instruction and Band A received instruction that did not include the use of singing. Krubsack reported significant results ($p < .05$) for the subjects who received singing instruction on their performance achievement in both parts of the study.

Bloedel Beery (1996) compared two approaches of instruction on elementary students' performance achievement. More specifically, the researcher sought to find differences in elementary students intonation, phrase shaping and musical expressions skills. Subjects for the fourteen-week study included 116 elementary band students who were randomly placed in control or experimental groups. The control group received traditional instruction without singing or vocalization while the experimental group received instruction that included the singing of rote songs. At the conclusion of the treatment period, the researcher administered a playing performance test using an etude. Although significant results were not found in intonation and phrase shaping scores, significant results were found between type of treatment and musical expression scores ($p = .0363$) favoring the experimental group. Bloedel Beery concluded that singing was effective for the development of musical expression in elementary band students.

Relating to Bloedel Beery's findings, Lee (1996) compared two different instructional methods on a subject's articulation and phrasing ability. Subjects were placed into a control or experimental group. The control group received traditional instruction while the experimental group included vocal pattern instruction. Lee reported significant results ($p < .05$) favoring the experimental group and concluded that the use of vocalization improves articulation and phrasing skills.

A majority of the aforementioned studies resulted with the researchers concluding that the use of vocalization in instrumental music instruction is an effective methodology (Bernhard, 2003; Bloedel Beery, 1996; Elliott, 1974; Grutzmacher, 1987; Jones, 2003; Krubsack, 2006; Lee, 1996; MacKnight, 1975). Even the studies that did not report significant results tended to have higher mean scores on post-tests favoring vocalization treatment (Bernhard, 2003, Coveyduck, 1998; Smith, 1984). Curiously, even with all the benefits that vocalization can provide, instrumental teachers are reluctant to include singing or vocalization as part of their teaching (Robinson, 1996). Burton (1986) sent out questionnaires to 200 high schools and 73 colleges to find the extent that vocalization was used in band rehearsals. After reviewing the questionnaires, Burton concluded that it was not frequently used.

Student resistance to singing

Researchers have examined student resistance to singing as well as students' attitudes toward singing. The resistance and negative attitudes students may harbor toward singing have been reported to be from a myriad of reasons which include home environment, childhood experiences with music, selection of music genre, ethnicity and age (Abril, 2007; Apfelstadt, 1989, Hedden, 2012).

It has been documented that student attitude toward singing declines with age and grade level (Mizener, 1993; Nolin, 1973; Phillip & Aitchison, 1998; Siebenaler, 2008; Vander Ark et al., 1980) and students become more resistant to singing instruction. One of the earliest studies to examine this was by Vander Ark, Nolin and Newman (1980). The purpose of their study was to determine the relationships of attitudes in students from grades three through six. Subjects included 5,642 students from sixteen schools enrolled in grades three through six. Subjects were administered the *Musical Attitude Inventory* by Nolin (1973) and the *Self-Esteem Inventory* by Coopersmith (1967). After analyzing the data, the researchers concluded that subjects' negative attitude toward singing significantly increased ($p = .00001$) by grade level.

In their study of attitudes about singing in elementary students, Phillip and Aitchison (1998) found similar results. More specifically, the purpose of their study was to investigate the relationship of psychomotor skills instruction to students' attitude toward singing and general music instruction. Subjects ($n = 269$) were students in grades four through six from a rural school district in Iowa. Subjects' general music classes remained intact and were randomly designated as control or experimental groups. Both groups received similar instruction twice a week for 40 minutes, however the experimental group received an additional 15 minutes of formal vocal instruction each week. At the end of the 27-week treatment period, subjects were given a survey which measured their attitude toward singing. Although the researchers did not find a significant difference between the control and experimental groups on the attitude survey, there was significance among the survey questions. Like the Vander Ark et al. study, the researchers concluded that interest in singing significantly decreases ($p < .001$) as students get older. The researchers further concluded that females had a more positive attitude toward singing and general music than did males ($p < .001$).

Siebenaler (2008) also examined the attitudes of elementary students toward singing. Very similar to the Phillip and Aitchinson study, the purpose of Siebenaler's study was to examine student attitudes toward singing and choir participation. Students ($n = 258$) in grades three through five from two public schools served as subjects. Subjects were administered a questionnaire about their attitudes toward singing and participation in choir. Through the analysis of a student questionnaire, Siebenaler was able to confirm that attitudes toward singing decline as grade level increases ($p < .05$).

The purpose of a study by Mizener (1993) was to examine the attitudes of elementary music students toward singing and choir participation in relation to gender, grade level, classroom singing activities and outside singing activity or experience. The researcher also sought to assess singing skill among the same factors. Subjects in the study ($n = 542$) were students in grades three through six. The subjects were given a questionnaire and recorded during a singing performance. Through analysis of the questionnaire, the researcher concluded that although the subjects' attitude toward singing decreased with age ($p < .001$), students from all three grade levels of subjects enjoyed the activity of singing. Additionally, the researcher also found significant differences ($p < .001$) in the responses from boys and girls on attitude toward singing. Boys were found to have a more negative response to the task of singing when compared to girls.

Nolin (1973) reported very similar results, he sought to examine what the effect of less frequent music classes had on the attitudes of students towards school music experiences. Nolin administered a questionnaire to subjects and found significance ($p < .05$) among factors. He concluded, "Even though attitudes declined as students grew older, ... sixth grade attitudes toward most singing activities were reasonably high" (p. 132). Nolin further explained that even

though subjects had negative feeling towards singing, it was specific to the situation. His questionnaire reported that subjects preferred to sing with accompaniment instead of without and that the favorite singing activity was in choir situations, specifically when they were preparing for a performance.

Boys' resistance to singing is a reoccurring theme in the research literature. Szabo (1999) states "By grade six, both boys' and girls' interest in singing decreases, but boys' interest declines significantly" (p. 13). Szabo explains that the reason boys are more resistant to singing comes from social pressures and states "As early as grade three, boys, as they become aware of and influenced by peer opinion, do not want to be associated with what they consider to be a girl's activity" (p. 13). Radkte (1950) concurs and states "Boys of this age, too, frequently use as an excuse for not singing the argument that singing is anything but masculine" (p. 48). Simply put, Phillips (1995) states that boys view singing as "not cool" (p. 28).

Instrumental music instruction in the elementary schools generally starts around fourth grade, which is when the decline of interest of singing starts in children (Mizener, 1993; Nolin, 1973; Phillips & Aitchison, 1995; Siebenaler, 2008; Vander Ark et al., 1980). With all the benefits that singing provides in instrumental instruction, the effects of alternate approaches to vocalization methods would be useful to music educators.

One such study was conducted by Bennett (1994) who used humming, which he labeled simple vocalization. The purpose of Bennett's study was to determine if brass and woodwind players would benefit from instruction using humming as a means of improving tuning procedures. Students ($n = 96$) in junior high and high school served as subjects for the study. Subjects were given a pretest designed by the researcher that consisted of different pitches to which the students tuned their instruments. After the pre-test, the humming treatment took place

over four instructional periods. At the end of the treatment period, subjects were administered the same test as a post-treatment measure. No significant differences were found between the pre- and post-test measures and Bennett concluded that humming did not improve intonation accuracy of students.

Sandor (1984) compared the use of singing to mouthpiece buzzing of brass players and its effect on pitch accuracy. Subjects included music majors that played brass instruments from a university. Sandor randomly assigned subjects to one of two different groups. One group was given a sequence of instruction of singing-buzzing while was given the sequence as buzzing-singing. Sandor found significant results ($p < .05$) and concluded that singing was more accurate in the performance of sight reading tasks than the buzzing of a mouthpiece. The researcher further concluded that buzzing should only used as a substitute for singing if students are given singing instruction prior to buzzing.

Schlacks (1981) examined the effect that vocalization had on the pitch accuracy of high school students. Students were placed in one of three experimental groups or a control group. One experimental group was given interval training through the use of an instrument, the second experimental group was given interval training through the use of the voice and the third experimental group was given interval training using a combination of both instrument and voice. At the end of the one-month treatment period, Schlacks administered the *Music Achievement Test* by Colwell (1967), the *Watkins-Farnum Performance Scale* (1954) and a researcher designed *Interval Performance Test* as post-tests. Schlacks reported that there were no significant results among treatments. However the post-test scores of the experimental group who had interval training both instrumentally and vocally, were higher than the scores of the other groups.

Frewen (2010) sought to examine the effects of familiarity of a melody on children's piano performance of the same melody. Although the study was not specifically about an alternate approach to singing, Frewen investigated the role listening had on subjects' performance ability. Students ($n = 97$) in kindergarten through fourth grade served as subjects for the study and were divided into a control or experimental group. Subjects in the control group were taught to play a short melody on the piano. Subjects in the experimental group were taught the same melody but heard the melody many times before being taught to play it. The researcher used a melodic error detection test to assess the familiarity of the melody with the subjects. Frewen reported significant results ($p < .01$) favoring the experimental group and concluded that subjects who were familiar with the melody had better performances and made less mistakes than subjects that were unfamiliar with the melody.

Both Bennett and Schlacks did not find significance in using an alternate technique to singing which indicates a need for further study. Sandor concluded that mouthpiece buzzing could be effective in developing pitch accuracy if it follows singing instruction. In Frewen's study, subjects became familiar with the melody they were performing by repeated listening. In both the Sandor and Frewen studies, it is plausible to say that the success seen by the students was due to their internalization of the melody or their ability to audiate it.

Audiation

Audiation is a term coined by Edwin Gordon, a prominent researcher and theorist in music education. Audiation is the basis of his explanation of how children learn music, *Music Learning Theory* (Gordon, 1997). Gordon defines audiation as "hearing and comprehending in one's mind the sound of music which is not or may never have been present" (p. 361). The term is often lumped together with other words that educators believe are the same, including: "inner-

hearing”, “aural imagery”, “aural perception” and “silent singing” (Walters, 1989). Gouzouasis (1994) states that audiation differs from the above terms because it is a cognitive process. He offers this explanation:

In a constructivist model of human learning, mental activity involves some aspect of cognition, namely thought. Similarly, in a constructivist model of music learning, “thinking musically” involves some aspect of cognition, or audiation. One uses the cognitive ability of thought when one speaks, listens, comprehends, and responds to speech in a linguistic context. One uses the cognitive ability of audiation when one sings, listens, comprehends, and responds to sound in a music context. Audiation is the ability to conceptualize and comprehend music when the sound of music is not physically present (p. 64).

Gordon (1997) also uses the analogy of language to explain the definition and process of audiation:

Although music is not a language, the process is the same for audiating and giving meaning to music as for thinking and giving meaning to speech. When you are listening to speech, you are giving meaning to what was just said by recalling and making connections with what you have heard on earlier occasions. At the same time you are anticipating or predicting what you will be hearing next, based on your experience and understanding. Similarly, when you are listening to music, you are giving meaning to what you just heard by recalling what you have heard on earlier occasions. At the same time, you are anticipating or predicting what you will be hearing next, based on your music achievement. (p. 5)

Through Gouzouasis’s and Gordon’s statements, it can be concluded that audiation is a cognitive process which encompasses more than other terms like “inner-hearing” or “aural imagery” may typically suggest.

According to Gordon (1997), there are eight types of audiation and six sequential stages.

The types are not sequential and are described as follows:

Type 1. Listening to familiar or unfamiliar music.

Type 2. Reading familiar or unfamiliar music.

Type 3. Writing familiar or unfamiliar music from dictation.

Type 4. Recalling and performing familiar music from memory.

Type 5. Recalling and writing familiar music from memory.

Type 6. Creating and improvising unfamiliar music while performing or in silence.

Type 7. Creating and improvising unfamiliar music while reading.

Type 8. Creating and improvising unfamiliar music while writing. (p.14)

The descriptions of the types of audiation further separate terms like “inner-hearing” because of the level of skill it takes to achieve. For example, most people would not find it difficult to achieve the level of audiation labeled as Type 1 but it would take a higher level of skill to recall and write music from memory as Type 5 describes. To simplify the types of audiation, Walters (1989) separates them into four categories by what “triggers” the audiation process. They are:

1. An external trigger through the sound of music (listening to music).
2. An external trigger through the sight of music notation (reading music).
3. An internal trigger through thought (recalling past music experiences).
4. An internal trigger thought with variation (creating or improvising music). (p. 6)

Gordon (1997) also lists six stages of audiation. The stages are sequential and are described as follows:

Stage 1. Momentary retention.

Stage 2. Imitating and audiating tonal and rhythm patterns and recognizing and identifying a tonal center and macrobeats.

Stage 3. Establishing objective or subjective tonality and meter.

Stage 4. Retaining in audiation tonal and rhythm patterns that have been organized.

Stage 5. Recalling in audiation tonal and rhythm patterns organized and audiated in other pieces of music.

Stage 6. Anticipating and predicting tonal patterns and rhythm patterns. (p. 18)

Audiation in instrumental music

The use of audiation in instrumental music instruction is becoming increasingly popular. According to Klemp (2009), an audiation-based approach to instrumental music differs from traditional instruction in three basic ways: 1) songs are taught by rote instead of through notation, 2) notes are not taught in isolation but instead through tonal and rhythmic patterns, and 3) tonal solfege and rhythm syllables are used instead of theoretical names given to pitches and rhythmic values. Many educators label this process as “sound before sight”. The sound before sight process has many benefits, one of which is the minimization of tasks to which a student must attend. Conversely in traditional instruction, students often learn the instrument and music notation concurrently. With so many tasks to attend to at once, a student, especially younger students, have difficulty learning in the traditional manner. Schleuter (1997) warns educators about this particular problem:

Many problems occur in beginning instrumental music instruction because of the common practice of beginning with the symbols rather than the sounds and omitting enough aural/oral practice and efficient verbal association of patterns. Students are mainly expected to learn the technical skills of instruments while associating fingerings with music notation. By skipping the musical readiness for notation, music symbols become visual cues for fingerings rather than for musical sounds. Instrument performance becomes analogous to typewriting series of words without understanding the language. (p. 37)

One of the most basic instructional techniques in a sound before sight approach is to teach students to sing or chant the exercise or song prior to having them perform it on an instrument. Surveys of popular instrumental music method books find that they do not incorporate singing (Brittin & Sheldon, 2004; Kretchmer, 1998). However, contemporary method books are starting to buck this trend and do incorporate singing. *Jump Right In: the instrumental series* (Grunow, Gordon & Azzara, 2001) lists detailed instructions for teaching students to sing songs before

they are expected to play them on an instrument. The process is called *Rote Song Procedure* and is listed as follows:

- Step 1. Just listen to the teacher sing the song (unaccompanied).
- Step 2. Move heels to macrobeats while listening.
- Step 3. Move hands (patsch lightly on thighs) to microbeats while listening.
- Step 4. Move to both macrobeats and microbeats while listening.
- Step 5. Audiate the resting tone while listening. Sing the resting tone after the teacher finishes singing the song.
- Step 6. Audiate the song.
- Step 7. Sing the song without accompaniment.
- Step 8. Sing the song with accompaniment. (p. 278)

Through these steps, the authors of *Jump Right In: the instrumental series* not only incorporate the singing of songs before performance on an instrument but are also advocating the use of having students audiate before performing on an instrument. In other words, students are taught to audiate a song and then sing the song before they are expected to perform it on an instrument.

Audiation studies in instrumental music education

Audiation is relatively a new term and not many studies focus on its use in instrumental music. Azzara (1993) sought to use audiation-based improvisation techniques on music achievement. The purpose of the study was to develop and examine instrumental music students' music reading achievement when improvisation is integrated into the curriculum. Subjects for the study included 66 fifth grade instrumental students from two different schools, all with one year of playing experience. Both the control and experimental groups were taught using the same text and recorded accompaniment but the experimental group integrated improvisation lessons

within their lesson period. The improvisation techniques were described by Azzara as audiation-based and included the singing of songs, the singing and chanting of tonal and rhythm patterns, and improvising tonic and dominant patterns with the voice. At the end of the treatment period, the subject's music reading achievement was measured by the performance of three etudes written by the researcher. A significant difference was found ($p = .0337$) and Azzara concluded that integrating audiation-based improvisational techniques into music instruction adds to the achievement level of fifth grade students' music reading ability.

Gamble (1989) examined two types of tonal pattern instruction on the audiation and performance skills of clarinet students. Subjects were 76 students in fourth and fifth grade, all of which were in their first year of clarinet lessons. The subjects were administered the *Musical Aptitude Profile* by Gordon (1965) as a pre-test measure and divided into three groups. Group 1 received traditional clarinet instruction while students in Group 2 and Group 3 received tonal pattern instruction that Gamble described as congruent to Music Learning Theory instruction. This included listening, singing, identifying, playing and reading patterns in major and minor tonalities. At the end of the 30-week study, students were given two researcher designed post-tests called the *Notational Audiation Test* and the *Instrumental Performance Test*. Significant results were found ($p < .05$) and Gamble concluded that Music Learning Theory instruction improved students' tonal understanding of major and minor tonalities during performance. Gamble also concluded that students taught using Music Learning Theory techniques had better skills in tonal audiation and music performance.

The Azzara and Gamble study investigated techniques associated with audiation or more specifically Music Learning Theory and their effects on subjects' performance achievement and audiation skills.

Error detection

Sheldon (2004) states “Detecting errors in musical performance is a fundamental part of the teaching and learning process in music education” (p. 1). The skill of error detection is especially important to beginning instrumental students because in many public school programs students are only seen for a 30-minute lesson once a week. During lessons, teachers identify errors for students and instruct on how to correct them. In a study by Taebel (1980), 201 public school music teachers were surveyed and asked to rate the importance of 59 competencies on the abilities of students to learn music. The highest rated competency was aural skills or more specifically, the ability to detect errors. Thornton (2004) states “The traditional instrumental music environment is teacher-centered: the music director alone detects and corrects errors in pitch, rhythm, phrasing, and other musical elements” (p. 1). This presents a problem for students while at home where they are expected to practice the assignment away from the teacher. During this time, students are expected to identify errors and correct them on their own without any guidance or help. Data suggest that parents may not be helpful in these situations due to the perception that they lack musical skill (Frederickson, 2000; Hennessy, 2000; Richards & Durrant, 2003; Strong, 2012). Therefore, the skill of self-error detection is necessary for students to become successful on their instruments.

Development of error detection skill

There have been contrasting opinions on what skills relate to error detection and how to best develop it. Brand and Burnsed (1981) conducted a study to find what music abilities or experience may serve as a predictor of error detection skill. The variables they examined as predictors included; number of instruments played, ensemble experience, ability in music theory, sight singing and ear training, and years of private instruction. The researchers reported that there

were no significant relationships between the variables and error detection skill. They concluded that error detection skill may be independently developed from other music abilities. Still, researchers have questioned how to best develop error detection skill. The efficacy of specific methods have been examined, one such method being the programmed instruction approach (Boyer, 1974; Costanza, 1971; Grunow, 1980; Ramsey, 1979; Stuart, 1979). Programmed instruction, sometimes called programmed learning, is an instructional technique developed by B.F. Skinner. Rogers (2002) defines programmed instruction as “students proceed at [their] own pace through a set of self-instructional materials, answering the embedded test questions as they occur” (p. 87). Although not as prevalent in schools today, programmed instruction was a very popular learning technique in the 1970s.

An early study by Ramsey (1979) examined the efficacy of this type of approach in teaching error detection skill to undergraduate music education majors. As characteristic with a programmed approach, Ramsey created an individualized program called *Program in Error Detection (PED)* for the subjects in his study to complete within a six-week time frame. Subjects were randomly assigned to either a control group who did not receive any programmed instruction or one of three treatment groups differentiated only by the length of the program. Students completed a researcher designed *Test in Error Detection (TIED)* as both a pre- and post-test measure. Ramsey concluded that a programmed instruction approach, more specifically his *PED*, is an effective approach in teaching error detection and that the longer forms of the *PED* were more effective when compared to the shorter forms. In other words, subjects’ ability to detect errors was improved with more practice.

Sidnell (1971), Constanza (1971) and Boyer (1974), investigated the use of programmed instruction on score reading ability. Within the studies, error detection is one of the attributes the researchers define as score reading ability.

Sidnell (1971) examined the use of programmed instruction on the abilities of undergraduate music majors' score reading skill. An experimental group used programmed material while a control group used non-programmed material. Significant differences were found ($p < .05$) favoring the experimental group suggesting that programmed instruction was effective in developing score reading skills, specifically the ability to detect and identify pitch and rhythm errors.

Much like Ramsey's study, Costanza (1971) created a programmed instruction method called the *Self Instructional Program in Score Reading (SIPSR)*. However, Costanza sought to measure score reading skills which he related to aural-visual discrimination. Concurring with Ramsey's results, Costanza also reported significant findings ($p < .05$) suggesting that programmed instruction through his *SIPSR* was effective in developing score reading and therefore the aural discrimination skills of undergraduate music majors.

Costanza's results were replicated by Boyer (1974) who also found significance ($p < .001$) in the use of programmed instruction for the development of undergraduate music majors' score reading skills. Boyer clarifies his definition of score reading ability as "the ability to read a score visually, to hear the sound of that score mentally, and to detect errors in a performance of the music" (p. iii). Today, the term "audiation" could be substituted for "hearing of the score mentally" as Boyer describes. Described earlier in this review, audiation is one of the factors in the proposed study.

Deal (1985) compared Ramsey's *PED* to a computer version of programmed instruction called the *Computer Assisted Program in Error Detection (CA-PED)*. Significant results from Deal's study suggested that both the *PED* ($p = .0001$) and *CA-PED* ($p = .0005$) were effective in improving the error detection abilities of college music majors. However, no significant difference was found between the *PED* or *CA-PED* suggesting that one method was not more effective than the other.

Although programmed instruction was a popular technique in the past, it is not widely used today. The lack of use may be due to its overall ineffectiveness. Hattie (2009) states "When comparisons are made between many methods, programmed instruction often comes near the bottom" (p. 231). The aforementioned studies all involve undergraduates in a music program as opposed to younger students in the public schools. Boden, Archwamety and McFarland (2000) suggest that older students are more successful with the approach because they are able to self-regulate their learning. Younger students may not be mature enough to monitor their own learning thus making programmed instruction a less desirable approach for that specific age level.

Outside of programmed learning, there are many studies that examine the efficacy of different approaches to developing error detection skill. As mentioned previously, a major portion of the research on error detection involves the way in which it relates to the visual notation of a musical score and the training of undergraduate students. In many cases, researchers sought ways to improve the score reading ability of college music education majors but reached mixed conclusions.

Grunow (1980) compared the effectiveness of four approaches to score study on the visual and aural discrimination skills of music educators. Approaches included study of the score

only, study of the score with recordings, recordings of the score only and no preparation.

Grunow concluded that all the approaches were effective in developing visual and aural discrimination skills and that no approach was significantly better.

A similar study conducted by Crowe (1996) examined four approaches of score study on the error detection abilities of music education majors. The approaches included no preparation, study of the score only, study of the score with the use of a piano and study of the score with a recording. Unlike the conclusions reached by Grunow, Crowe found that the approach using the score with a recording was significantly better ($p < .05$) over the other approaches.

Contrasting Crowe's results, Hochkeppel (1993) also compared the effects of four different approaches of score study on the error detection abilities of music education students. Hochkeppel compared study of the score with the use of a piano, study of the score with a recording, study of the score with the use of singing and study of the score alone. Significant results were found ($p < .05$) favoring study of the score with singing and study of the score alone.

Doane (1989) compared the effectiveness of two different approaches on the development of error detection skill. One approach was audio based while the other was researcher created and included videos, workbooks and the actual experience of conducting a live ensemble. Doane reported that both approaches were effective in the development of error detection skills, neither one was more significant than the other.

According to the studies described above, there is no superior method to improve the development of error detection skills in regards to reading a musical score. However in the studies by Grunow, Crowe and Doane, listening to a recording of the music significantly improved error detection skill. Through these findings, it can be concluded that listening to a correct example of the score is an effective means of improving error detection skill.

Listening and error detection skill

Sheldon (2004) investigated the effects of multiple listenings on error detection skill of undergraduate brass and woodwind music majors. Subjects were asked to listen to an excerpt of music while looking at a score and circle areas of the score with a blue pen where they heard an error occur. Subjects heard the excerpt a second time and circled errors with a red pen and heard the excerpt a third time and circled errors with a green pen. Sheldon concluded that multiple listenings did not improve error detection skills in undergraduate music majors.

Bundy (1987) examined the ability for junior high instrumentalists to listen for errors in their own performance. Subjects were first asked to detect errors in their own performance. Two weeks later, the subjects were asked to listen to recordings of the performances and asked to identify errors. Bundy concluded that subjects were better at detecting errors when they were listening to the recordings as opposed to detecting errors while performing on their instruments.

Thornton (2004, 2008) conducted two studies with similar purposes. In both studies, woodwind students in fifth and sixth grade were used as subjects. Subjects were placed into a group that detected errors by listening to themselves while playing and a second group that detected errors while listening to recordings. In both cases, Thornton did not find any significant results among treatments. However in her 2008 experiment, Thornton did report that subjects had high error detection scores when detecting errors in familiar music. Through this finding, Thornton suggested that error detection is a skill that even students with only one year playing experience can be successful with.

The number of parts a subject is listening to or viewing plays a role in their ability to detect errors. Subjects are more accurate in identifying errors in single lines of music as opposed to multiple lines of music which are typically found in a musical score. (Byo, 1997; Crowe,

1996; Sheldon, 1998; Sheldon, 2004) Also, both Byo (1997) and Sheldon (1998) conclude that subjects are able to identify rhythm errors with more accuracy than tonal errors.

Relationship of singing to error detection skill

According to Thornton (2008), the relationship of singing and error detection is uncertain. The uncertainty is due to the conflicting results and conclusions of existing studies. There are a handful of studies that specifically examine the relationship of singing to error detection.

Larson (1977) examined the relationship between error detection, sight singing and melodic dictation skills. Undergraduate music majors ($n = 90$) in their junior and senior year were used as subjects in the study. Although Larson found significant relationships ($p < .05$) between all three variables in the study, he noted that the relationships were generally stronger between error detection and melodic dictation ability as opposed to error detection and sight singing ability.

Sheldon (1998) conducted a study similar to Larson and examined the role sight singing and aural skills training had on error detection abilities. Subjects ($n = 30$) were undergraduate music majors from a university. Subjects in the study received similar instruction but the experimental group received 50 minutes of additional instruction that included sight singing. Like Larson, Sheldon found significant results ($p < .01$) favoring the subjects who had sight singing and aural skills training in their ability to detect errors.

Killian (1991) studied the relationship between sight singing accuracy and error detection ability. She used 75 seventh and eighth grade choir students as subjects in the study and administered a self-designed test to measure sight singing ability. Subjects were identified as high, medium or low scoring sight singers. Killian developed another test to measure error

detection skill and compared it to the sight singing ability of subjects. No significant differences were found between high and medium sight singers in error detection skill. However, high ability sight singers scored the highest on the error detection measure, followed by medium ability sight singers and then low ability sight singers. Additionally, low ability sight singers were found to be significantly accurate ($p < .01$) in error detection. Students who struggled in sight singing were still able to detect errors successfully. Killian suggested that skill in error detection may be developed separate and not necessarily related to sight singing ability.

Geringer (1983) examined the relationship of pitch matching and pitch discrimination abilities. Subjects were 144 students who were in preschool or fourth grade. All the subjects were administered a pitch discrimination test and a vocal pitch matching test. Geringer reported a significant correlation ($r = .61, p < .01$) between pitch matching and fourth graders who were classified as having high pitch discrimination ability. He did not find significance or correlations with any of the other variables. Through the data, Geringer concluded that pitch matching and pitch discrimination may be two different skills that develop with age.

Results of two older studies dismiss the relationship between singing and pitch discrimination. Pedersen and Pederson (1970) found low and moderate relationships between singing and pitch discrimination while Porter (1977) suggests that pitch perception has no relation to faulty singers.

Singing has also been found to have a negative effect on the ability to detect errors. Byo and Sheldon (2000) conducted a study involving the ability of undergraduate music majors to detect rhythm and pitch errors in one, two or three part textures. Subjects were given an error detection pre-test and then asked to learn the score through singing. Prior to the post-test, subjects were assigned to either a singing group which was asked to sing while locating errors

during a listening test or a non-singing group who detected errors without singing. This approach was similar to the way the pre-test was taken. Byo and Sheldon reported that singing had no effect on the subjects' ability to detect errors in one-part texture but a negative effect in textures comprised of two or three parts.

Although Larson and Sheldon (1998) reported positive relationships between error detection, ability to take melodic dictation and sight singing, the other literature on the variables that relate to error detection are not as consistent. Through these studies (Brand and Burnsed, 1981; Geringer, 1983; Killian, 1991; Pedersen and Pederson, 1970; Porter, 1977) error detection seems to be unrelated and developed separately from ones' ability to perform vocally. In fact, according to Byo and Sheldon (2000), singing may have a negative effect on the ability to listen for errors in polyphonic textures.

The relationship of singing to error detection remains unclear. Interestingly, in Killian's study, all the subjects were able to detect errors regardless of sight singing ability. Even the low ability sight singers were still able to detect errors at a significant level. Perhaps the subjects were able to identify the errors not because of singing ability but rather because of audiation ability. If these subjects were not comfortable with the physical act of singing, audiation may be a viable substitute. In fact, Sheldon (2004) believes that audiation, to some extent, is related to the development of error detection abilities.

Summary

The use of singing as a pedagogical tool in instrumental music has been well documented in past research. It has been successfully used to improve intonation, sight reading achievement, pitch accuracy, articulation and phrasing and performance achievement. However, singing is not widely used in beginning instrumental lessons. This may be due to teachers' and students'

comfort level with singing. Researchers concluded that resistance to singing was especially found in older elementary students and more specifically, boys. Not many studies exist that examine an alternate technique to singing in instrumental music education, including the use of audiation.

The ability to detect errors is an important skill in music education, however there are contrasting opinions on how to best develop it. Also, a review of the literature shows that the relationship between error detection and singing is unclear. Lastly, there is a lack of research that investigates the relationship between error detection and audiation.

CHAPTER THREE

Method

Research design

The present study was experimental in design and included a control and two treatment groups.

Research method

The researcher investigated the effects of two different approaches, audiation and singing, on the error detection skills of beginning band students.

Subjects.

The sample included fourth and fifth grade students ($N = 108$) in their first or second year of study on band instruments, all of whom were taught by the researcher. Students playing the flute, clarinet, alto saxophone, trumpet, trombone, baritone horn and tuba were included in the study. Percussionists were excluded from the study because they learn to play the snare drum during the first year of study and the bell/glockenspiel during the second year. The lack of a tonal instrument during their 4th grade year eliminated percussion students as viable subjects for the study. Subjects that were involved in the study are listed in Table 1.

Table 1

Subject Profile by School and Grade

	School One $n = 53$	School Two $n = 55$	Total $N = 108$
Grade 4	30	35	65
Grade 5	23	20	43

Setting.

The sample for the study consisted of fourth and fifth grade students enrolled in the instrumental music program within the Cherry Hill Public Schools. Located in Southern New Jersey, the Cherry Hill Public Schools serve students in grades pre-kindergarten through twelve. The school district consists of one pre-school, twelve elementary schools, three middle schools, and three high schools. Subjects used for this study were from two different elementary schools where the researcher was employed as the instrumental music teacher.

Procedure.

After receiving approval from the Rutgers University Institutional Review Board, a letter was sent to the following people in the Cherry Hill Public Schools in the spring of 2013 requesting permission to perform research on the subjects: the principals of Sharp and Bret Harte Elementary Schools, the district Supervisor of Music and the Superintendent of the Cherry Hill Public Schools (Appendix A).

After approval was granted by the district, a parent information letter that described the study was sent home with the students to request permission for participation in the study in the fall of 2013. The letter briefly described the purpose and procedures of the study (Appendix B).

Prior to the treatment, subjects were given a questionnaire for the purpose of collecting information on their individual backgrounds (Appendix C). Researchers have concluded that past musical experience could positively affect student music performance (Coveyduck, 1998; Elliot, 1974; Kuhlman, 1996). Past experience that has been found to be a factor includes private lessons on piano, voice or another instrument, and level of musical background in the family home. More specifically, Eu (1972) and Geringer (1983) found that prior experience in music

could affect error detection ability. Identifying these students prior to the study allowed the researcher to control for variability by randomizing.

Students used as subjects in the study had some prior musical experience from the general music classes offered in the district. However, the prior experience from general music classes was considered not to be a factor because both schools follow the same music curriculum that is overseen and mandated by the district.

Also prior to treatment, all subjects were administered the *Intermediate Measures of Music Audiation* (Gordon, 1982) to determine their level of music aptitude. A comparison of the students' raw scores from the tonal subtest was used to examine the relationship it shares with the ability to detect errors.

The subjects' instrumental music classes remained intact and were homogeneously grouped by school, instrument and grade level. Each group was randomly assigned as a control group, audiation-based treatment group or singing-based treatment group (Table 2). The control group (CG) received traditional instruction and was taught using notation. Subjects placed in this group did not receive instruction through audiation or singing. Students placed in the audiation-based treatment group (AG) received the same instruction as the control group with the addition of becoming familiar with the songs through audiation. This group did not receive any singing instruction. The singing-based treatment group (SG) received the same treatment as the AG including becoming familiar with the songs through audiation but was also given singing instruction. The purpose of the control and treatment groups was to determine if there were any significant differences in students' ability to detect errors among treatment.

Table 2

Subject Profile by Grade and Treatment Group

	Audiation Treatment <i>n</i> = 33	Singing Treatment <i>n</i> = 39	Control <i>n</i> = 36
Grade 4	21	24	18
Grade 5	12	15	18

The process of teaching the songs by rote was taken and adapted from the teachers manual of *Jump Right In: the instrumental series* (Grunow, Gordon & Azzara, 2001) and is called *Rote Song Teaching Procedure* (p. 278). The procedure used was as follows:

1. The researcher established the tonality of the song to be learned on the piano.
2. The researcher sang the song to the subjects.
3. The researcher sang the song to the subjects a second time and instructed the subjects to keep a steady beat (macrobeat) with their feet.
4. The researcher sang the song to the subjects a third time and instructed the subjects to patsch the steady beat (microbeat) on their laps.
5. The researcher asked the students to audiate the song.

This first part of the procedure was identical for both the *SG* and *AG* treatment groups. The *SG* had an additional step in the procedure and the subjects were asked to sing the rote song. The *AG* stopped at the fifth step, only audiating the song and did not sing it. The *CG* did not follow the *Rote Song Procedure* and received no audiation or singing instruction during the treatment period.

The above procedure took place during an eight-week treatment period and was implemented during the weekly group lessons of the students, all of which was taught by the

researcher. The treatment period was chosen to be eight weeks due to the school calendar. If the treatment period were longer, the testing procedures would have been interrupted by holidays when the school was closed and caused possible validity issues. The treatment took place during the first five minutes of each lesson and consisted of learning a song through the *Rote Song Procedure*. One song was taught each week, making a total of eight songs at the completion of the treatment period. The songs used for treatment were from popular elementary band and orchestra method books and can be found in Appendix D. According to Grunow, Gordon & Azzara (2001), children have limited vocal ranges and care should be taken to have students perform in keys that put the melody in a comfortable range allowing them to sing easily. Phillips (1992) states that 4th and 5th grade students sing most comfortably in the d1-d2 range (p. 59). The songs used for treatment were transposed to the keys of D major or G major and adhered to the guideline by positioning the melody in a comfortable singing range for the subjects.

At the end of the treatment period, subjects were administered the *Error Detection Test (EDT)*. The test and testing procedures were adapted from the error detection test created by Thornton in her 2008 experiment. The notation for the songs was created using the *Sibelius* notation software, version 7.1.3. The *Sibelius* software was also used to create an audio track for the *EDT*. The last four songs used for treatment were used as practice tests and were administered identically to the *EDT* starting on week 5 of the treatment period. The purpose of the practice tests were to allow the subjects to become familiar with the testing process of the actual *EDT*.

The test created by Thornton was used to measure the error detection abilities of beginning woodwind students in two different listening conditions; listening while playing an instrument and listening only. Thornton chose to use highly familiar songs; Twinkle Twinkle

Little Star, Happy Birthday, This Old Man and Old MacDonald Had a Farm. When testing for error detection, Thornton simply placed the familiar song in a unfamiliar key. The purpose of this study was to compare the treatments of audiation and singing on a students' ability to detect errors, therefore Thornton's error detection test had to be altered. The songs chosen for the study had to be unfamiliar to the subjects. To accommodate this, the melodies were chosen from popular beginning band methods books. They were unfamiliar to the subjects because they were composed specifically by the authors of the books for use in their method.

The songs selected for the testing procedure adhered to Thornton's original rhythmic and melodic guidelines. Being from elementary band methods, the melodies were at an appropriate level for the subjects and were not too melodically or rhythmically difficult. The songs selected for use in the study mostly followed a stepwise pattern and did not have interval leaps larger than a major third. The rhythms were simple and consisted of quarter and eighth notes. Uneven rhythms, syncopation or dotted values were not in the selected melodies. As stated previously, children have a limited vocal range so the melodies for the error detection test were transposed to D or G major so the singing range is comfortable for the subjects. Melodies selected for the testing procedure are listed in Appendix E.

Thornton planted tonal errors in her version of the error detection test because past literature concluded that inexperienced students were likely to detect them. She created the errors by altering a note one half step. The melodies that contain errors in the present study were congruent with Thornton's original test and had tonal errors of one half step.

Subjects were asked to listen to a recording of the song they recently learned using the *Rote Song Procedure* and circle errors they heard on provided response sheets (Appendix E). Students in the *CG* were asked to identify errors without any singing or audiation instruction.

The response sheets included the notation of the song and a question as to whether or not they perceived an error. If students did perceive an error, they were asked to circle the notation where they believe the error occurred. Subjects also had the option of selecting “not sure”. The recordings of the melodies and the corresponding response sheets were in concert B flat major. The key of B flat major kept the notation of the melody in a key familiar to the subjects.

Scoring for the listening test also followed the procedures used by Thornton. Subjects received two scores, one for identifying the melody as correct or incorrect and a second set of scores for the identification of errors in a song they listed as “incorrect”.

For the first task, subjects received three points if they correctly identified a test example as “correct” or “incorrect”. If the subjects incorrectly identified a test example as correct when it was incorrect or vice-versa, they received zero points for the task. Subjects who answered “not sure” received one point.

For the second task, subjects received scores for their identification of errors by circling notation. If subjects were able to correctly identify the location of the errors, two points were given. If a subject was able to identify the location of an error but also identified correct pitches as incorrect, only one point was given. Lastly, if the subject incorrectly identified the errors no points will be given.

The *EDT* contained four subtests or a total of four songs (Song A, B, C & D). Two were correct (A & C) and contained no errors. The remaining two tests (B & D) contained errors and were incorrect. A subject could obtain a perfect score in the first task by identifying the two correct melodies as “correct” and receive three points each and the two incorrect melodies as “incorrect” and receive three points each (a total of 12 points). The subject would also have to identify the errors correctly in the incorrect melodies (two points each melody) to receive a

perfect score of four points in the second task. A perfect score in both task one and task two would be a total of 16 points.

Subject's responses on the test were graded and recorded by the researcher. Two other music educators in the district, both with over 10 years experience, also graded the tests to ensure the scoring was accurate.

Data analysis

The study attempted to answer the following research questions.

1. Will the melodic error detection abilities of beginning instrumentalists be affected by instruction that includes audiation techniques?
2. Is there a significant difference between audiation and singing in the ability of beginning instrumentalists to detect melodic errors?

A secondary question of the study included:

1. Does level of music aptitude relate to students' ability to detect melodic errors?

The statistical procedure used to analyze the data from the error detection test was a Nested Analysis of Covariate (ANCOVA). Music aptitude served as a covariate. The reason for the nested model was because subjects were homogeneously grouped by instrument, school and grade level prior to the study. The nested design allowed the data to be examined by treatment group and the individual group where they received the instruction. A separate Analysis of Variance (ANOVA) was calculated to answer the secondary question of how aptitude is related to the ability to detect errors.

Protection of human subjects

After receiving approval from the Rutgers University Institutional Review Board via the Office of Research and Sponsored Programs to proceed with the study, the researcher began the process of recruiting the subjects in September which is the start of the school year. The

researcher assigned a unique code to each subject upon consent. The researcher entered all data from the study using the code for each subject. Only the principal researcher was able to associate the codes to the individual subjects. Finally, no names of subjects were used in the publications or presentations of the study.

The researcher kept the subjects' test and survey scores in a locked folder on the researcher's personal computer and it was backed up on a separate hard drive. Any paper files containing information on the subjects was located in a locked filing cabinet in the researcher's home. All data belonging to the study was destroyed at the end of three years as mandated by the Institutional Review Board.

CHAPTER FOUR

Results

Research Questions

The purpose of this study was to examine the use of audiation on the melodic error detection ability of beginning instrumentalists. Two primary research questions were investigated. The research questions were:

1. Will the melodic error detection abilities of beginning instrumentalists be affected by instruction that includes audiation techniques?
2. Is there a significant difference between audiation and singing in the ability of beginning instrumentalists to detect melodic errors?

A secondary question investigated the role of tonal aptitude on the error detection abilities of beginning instrumentalists. Therefore a secondary research question of the study was:

1. Does level of music aptitude relate to students' ability to detect melodic errors?

The significance level for hypothesis testing for both the primary and secondary research questions was set at the $p < .05$ level.

Subjects for the study ($N = 108$) included fourth grade ($n = 65$) and fifth grade ($n = 43$) students in their first or second year of study on band instruments. Subjects were from two different elementary schools within the Cherry Hill (NJ) Public Schools. Subjects who played the flute, clarinet, alto saxophone, trumpet, trombone and tuba were eligible as subjects for the study. Permission for the study was granted by the Rutgers Institutional Review Board, the individual principals of both elementary schools and the district Superintendent of Schools in the spring of 2013. The research took place during the following fall semester of the 2013-14 school year. Prior to the start of the study, parental and student permission forms were sent home. Out of a pool of 109 eligible subjects, 108 returned the permission forms and consented to be

participants. Prior to the start of the study, subjects were grouped homogeneously by instrument, grade level and school. These predetermined groups were randomly assigned as a control group, audiation-based treatment group or singing-based treatment group.

Tonal aptitude

Once the subjects returned consent forms, they were administered the tonal subtest from the *Intermediate Measures of Music Audiation (IMMA)*. Subject's scores were used as a covariate to control for uneven differences in tonal aptitude among treatment groups that might give one group an advantage over another. The mean for the Audiation group (AG) was 35 with a standard deviation of 2.9; the mean for the Singing group (SG) was 36 with a standard deviation of 1.9; and the mean for the control group (CG) was 36 with a standard deviation of 2.2 (Table 3).

Table 3

Mean, Standard Deviation, Median and Range of IMMA by Treatment Group

	<i>N</i>	Mean	<i>SD</i>	Median	Range
Audiation Group	33	35	2.9	36	11
Singing Group	39	36	1.9	36	9
Control Group	36	36	2.2	36	11

Note. The maximum possible score on the *IMMA* was 40.

Student questionnaire

After being administered the tonal portion of the *IMMA*, subjects were given a questionnaire to measure their prior music experience. The questionnaire contained six items that inquired about the subject's past experience with music including piano lessons, voice lessons and experience with another instrument. The questionnaire was scored on an additive scale with

each “Yes” answer counting as one point. A subject could score zero through six points on the questionnaire with zero representing no experience and a higher number indicating a larger amount of past experience with music. The mean for amount of prior music experience for the *AG* was .7 with a standard deviation of 1; the *SG* had a mean of 1.4 and a standard deviation of 1.5; and the *CG* had a mean of 1.2 with a standard deviation of 1.4 (Table 4). An Analysis of Variance (ANOVA) revealed no significant differences, $F(2, 105) = 2.171, p = .119$, indicating that the means for the three groups were statistically the same, and therefore, all groups started the experiment with an equal amount of musical experience (Table 5).

Table 4

Mean and Standard Deviation for Prior Musical Experience by Treatment Group

	<i>N</i>	Mean	<i>SD</i>
Audiation Group	33	.7	1
Singing Group	39	1.4	1.5
Control Group	36	1.2	1.4

Note. 0 = No musical experience, 6 = most musical experience.

Table 5

Analysis of Variance of Experience Questionnaire by Treatment Group

Source of Variation	Dependent Variable	Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	<i>p</i>
Treatment Group	<i>Experience Questionnaire</i>	7.890	2	3.945	2.171	.119
Error	<i>Experience Questionnaire</i>	190.776	105	1.817		
Total	<i>Experience Questionnaire</i>	529.453	107			

Error detection test

After the treatment period, subjects took the *Error Detection Test (EDT)*, which consisted of four different subtests (Song A, B, C & D). Two of the subtests (A & C) were correct and did not contain errors. The remaining two subtests (B & D) contained errors. Each subtest had two tasks, the first was identifying if the song heard was correct. The second task was identification of the error in Song B & D. A subject could obtain a perfect score in task one by identifying the two correct melodies as “correct” and receive three points each and the two incorrect melodies as “incorrect” and receive three points each (a total of 12 points). The subject would also have to identify the errors correctly in the incorrect melodies (two points each melody) to receive a perfect score of four points in task two. A perfect score in both task one and task two would equal a total of 16 points.

The scores of the four subtests (Song A, B, C & D) were combined to make a total score for each subject. Mean scores for the error detection tests are shown in Table 6. The AG had a mean score of 12.21 with a standard deviation of 4.30; the SG had a mean of 12.72 with a standard deviation of 4.21; and the CG had a mean of 11.11 with a standard deviation of 4.72.

Table 6

Mean, Standard Deviation, Median and Range of EDT by Treatment Group

	<i>N</i>	Mean	<i>SD</i>	Median	Range
Audiation Group	33	12.21	4.30	14	13
Singing Group	39	12.72	4.21	16	13
Control Group	36	11.11	4.72	11.5	16

Note. The maximum possible score on the *EDT* was 16.

Dependent variable

In order to answer the research questions, the subject's score totals on the *EDT* were analyzed using a Nested Analysis of Covariance (ANCOVA). A Nested ANCOVA design was necessary because the subjects that comprised the treatment groups were given instruction in pre-determined, small clusters of lesson groups and were statistically nested within the treatment. The treatment group served as a factor and tonal aptitude was the covariate. The results from the Nested ANCOVA were used to answer the primary research questions of the study and are found in Table 7.

Table 7

Nested Analysis of Covariance of EDT by Treatment Group Adjusting for Tonal Aptitude

Source of Variation	Dependent Variable	Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	<i>p</i>
<i>IMMA</i>	<i>EDT</i>	36.908	1	36.908	2.229	.139
Treatment Group	<i>EDT</i>	17.704	2	8.852	.390	.680
Nesting	<i>EDT</i>	638.712	24	26.613	1.607	.060
Error	<i>EDT</i>	1012.341	44.568	22.715		

Research question one and two

The first and second research questions of the study were similar. The first question inquired if the melodic error detection abilities of beginning instrumentalists would be affected by instruction that includes audiation techniques. The second question inquired if there was a significant difference between audiation and singing in the ability of beginning instrumentalists to detect melodic errors. The means of the *EDT* in Table 6 report that the *AG* and *SG* had comparable scores. The *SG* scored the highest with a mean of 12.72 with a standard deviation of

4.21 while the *AG* had a mean of 12.21 with a standard deviation of 4.30. Both treatment groups scored higher than the *CG* which, had a mean of 11.11 and a standard deviation of 4.72.

However, results of the Nested ANCOVA (Table 7) revealed that there were no significant differences between treatment groups in the ability to detect errors, $F(2, 44) = .390, p = .680$.

Also, no significant differences were found among the specific nesting of groups, $F(24, 80) = 1.607, p = .060$.

Research question three

The third research question inquired if the level of tonal music aptitude relates to students' ability to detect melodic errors. Subject's scores from the tonal aptitude portion of the *IMMA* were converted to standardized scores and each subject was designated as having a high, medium or low music aptitude using the procedure outlined in the *IMMA* testing manual. The means and standard deviations of the *EDT* for high, medium and low tonal aptitude subjects are shown in Table 8. The high tonal aptitude subjects had a mean of 14.33 with a standard deviation of 3.5; the medium tonal aptitude subjects had a mean of 11.62 and a standard deviation of 4.5; and low tonal aptitude subjects had a mean of 10.89 with a standard deviation of 4.0.

Table 8

Mean and Standard Deviation of EDT by Tonal Aptitude

	<i>N</i>	Mean	<i>SD</i>
High	21	14.33	3.5
Medium	68	11.62	4.5
Low	19	10.89	4.0

The scores for the *EDT* were subjected to an ANOVA with high, medium and low designations of tonal aptitude serving as factors and is shown in Table 9. Significant results were found, $F(2, 105) = 3.989, p = .021$ between factors. Tukey HSD post hoc analysis (Appendix F, Table 13) revealed a significant difference favoring subjects designated as having a high tonal aptitude over medium and low tonal aptitude students.

Table 9

Analysis of Variance of EDT by Level of Tonal Aptitude

Source of Variation	Dependent Variable	Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	<i>p</i>
Tonal Aptitude	<i>EDT</i>	147.448	2	73.724	3.989	.021
Error	<i>EDT</i>	1940.515	105	18.48		
Total	<i>EDT</i>	2087.963	107			

Separate ANOVA's were performed on the individual subtests (Song A, B, C & D) of the *EDT*. No significant differences were found ($p > .05$) on Song A or B, however results for Song C approached significance, $F(2, 105) = 2.860, p = .062$ and significant results were found on Song D, $F(2, 105) = 5.240, p = .007$. Means for Song C and D can be found in Table 10 and 11 respectively. The results of the ANOVA for Song D can be found in Table 12. For both Song C, $F(2, 105) = 15.214, p = .0001$ and Song D, $F(2, 105) = 5.198, p = .007$, Levene's Test of Equality reported that there was a failure of equal variance within the ANOVA, which resulted in the use of a Games-Howell post hoc test to control for the variance among groups yet still identify the significance difference among factors.

Table 10

Mean and Standard Deviation of Song C of EDT by Tonal Aptitude

	<i>N</i>	Mean	<i>SD</i>
High	21	2.81	.81
Medium	68	2.13	1.29
Low	19	2.57	1.01

Note. The maximum possible score on Song C was 3.

Table 11

Mean and Standard Deviation of Song D of EDT by Tonal Aptitude

	<i>N</i>	Mean	<i>SD</i>
High	21	4.23	1.70
Medium	68	3.07	2.22
Low	19	2.05	2.24

Note. The maximum possible score on Song D was 5.

Table 12

Analysis of Variance of Song D by Level of Tonal Aptitude

Source of Variation	Dependent Variable	Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	<i>p</i>
Tonal Aptitude	<i>Song D</i>	48.046	2	24.023	5.240	.007
Error	<i>Song D</i>	481.389	105	24.023		
Total	<i>Song D</i>	529.453	107			

Although the results only approached significance for Song C ($p = .062$), the post hoc test revealed significant results ($p = .022$) among aptitude level (Appendix F, Table 14). The significant difference was found between high and medium aptitude students favoring high aptitude. The means for Song C were not in the expected linear order. The mean for high aptitude subjects was 2.81 with a standard deviation of .81; the mean for the medium aptitude subjects was 2.13 with a standard deviation of 1.29; and the mean for the low aptitude subjects was 2.57 with a standard deviation of 1.01.

Results of the post hoc test on Song D (Appendix F, Table 15) revealed a significant difference between high and medium tonal aptitude subjects ($p = .044$) favoring high aptitude and also between high and low tonal aptitude subjects ($p = .005$) also favoring high aptitude. The means for Song D were in the expected linear order. The mean for high aptitude subjects was 4.23 with a standard deviation of 1.70; the mean for the medium aptitude subjects was 3.07 with a standard deviation of 2.22; and the mean for the low aptitude subjects was 2.05 with a standard deviation of 2.24.

CHAPTER FIVE

Discussion

The present study compared the use of vocalization methods on beginning instrumental students' ability to detect tonal errors. More specifically, the study sought to answer the following questions: 1) will the melodic error detection abilities of beginning instrumentalists be affected by instruction that includes audiation techniques; and 2) is there a significant difference between audiation and singing in the ability of beginning instrumentalists to detect errors? A secondary question was 1) does level of tonal music aptitude relate to a student's ability to detect tonal errors?

Subjects ($N = 108$) were grouped homogenously by instrument, grade level and school. Prior to treatment, subjects were administered Gordon's (1982) *Intermediate Measures of Music Audiation (IMMA)* as a questionnaire to measure past experience with music. Each grouping of subjects was then assigned as part of the Audiation Group (AG), Singing Group (SG) or Control Group (CG). During the eight-week treatment period subjects were taught songs by rote. The SG became familiar with the songs by learning to first audiate them and then sing them according to a procedure outlined in the *Jump Right In: Instrumental Series* band method book. Subjects in the AG became familiar with the songs using the same procedure but omitted the singing step. Subjects in the CG did not receive instruction that included audiation or singing.

Subjects were asked to complete two tasks on a test adapted from a 2004 study by Thornton renamed for the current study as the *Error Detection Test (EDT)*. The first task was to identify a recording of the song they had become familiar with through the *Rote Song Procedure* as "correct" or "incorrect". The second task was to identify the location of the error by circling the notation of songs they labeled "incorrect".

Prior to the *EDT*, students were given practice tests starting on week four of the treatment period. The practice tests coordinated with the melodies they were being taught as part of the treatment. They were identical to the *EDT* and assisted the subjects in becoming familiar with the test. As a result, subjects were comfortable with the tasks and procedures of the actual *EDT* after the treatment period had ended and the testing phase began.

Data was analyzed using a Nested ANCOVA, which revealed that there were no significant differences ($p > .05$) between the two treatment groups (*SG* and *AG*) or the control group (*CG*). Therefore the first null hypothesis that stated: melodic error detection ability will not be affected by instruction that includes audiation techniques, was not rejected. The second null hypothesis, there will be no difference in the melodic error detection abilities of students among treatment groups, was also not rejected. Based on data acquired from the study, it may be concluded that the use of instruction that includes audiation techniques does not have an effect on students' ability to detect errors. It can also be concluded that there is no significant difference between instruction that includes audiation and instruction that includes singing in the ability to detect melodic errors.

An ANOVA comparing level of tonal aptitude and the scores from the *EDT* revealed significant results ($p = .021$) favoring the subjects with high tonal aptitude. Highly significant differences ($p = .007$) were found on an ANOVA for Song D, a subtest of the *EDT*, which also favored high tonal aptitude subjects. Therefore, the third null hypothesis that stated, there will be no difference between melodic error detection ability and level of tonal aptitude, was rejected. Based on data from the study, it can be concluded that high aptitude students are better at detecting melodic errors than average or low tonal aptitude students.

Conclusions

The use of singing and vocalization in instrumental music lessons has been well documented by music educators (Erwin, et al., 2003; Leonard & House, 1959). However, despite these suggestions, teachers of instrumental music still fail to include vocal activities as part of their instruction (Dalby, 1999; Robinson, 1996; Schleuter, 1997; Wolbers, 2002). The primary focus of this study was to examine the use of audiation on the melodic error detection ability of beginning instrumentalists. Results of the study suggest that audiation was not an effective technique in developing a student's ability to detect melodic errors. Unlike conclusions made in a number of prior research, singing was not found to be an effective instructional technique in this study.

Audiation instruction and error detection ability.

Although the mean scores for the *AG* on the *EDT* were higher than the *CG*, it was not at a statistically significant level ($p > .05$). There are no past studies that specifically examined the role of audiation instruction on error detection ability but the results of the current study contradict related studies by Azzara (1993) and Gamble (1989) who concluded that audiation was beneficial as a teaching technique. Azzara examined audiation-based improvisation techniques on music achievement of fifth grade instrumental students. Azzara concluded that integrating audiation-based improvisational techniques into instruction adds to the music achievement, or more specifically, the music reading ability of fifth grade instrumental students. Gamble compared two types of tonal pattern instruction on the audiation and performance skills of fourth and fifth grade clarinet students. Gamble concluded that Music Learning Theory instruction, which included audiation techniques, improved students' understanding of major and minor tonality, tonal audiation skill and overall music performance.

To explain the discrepancy of results between the current study and the findings of Azzara and Gamble, the length of the experiments should be considered. Azzara's treatment period lasted 27 weeks and Gamble's treatment period lasted 30 weeks. The treatment period for the current study was much shorter and only lasted a total of eight weeks. The length of the treatment period for the current study was determined in large part by the school calendar. The mean scores of the treatment groups on the *EDT* were higher than the mean scores of the *CG*. If the current treatment period were extended to the length of the Azzara or Gamble study, different results may have occurred.

Studies by Thornton (2004) and Sheldon (2004) investigated the role of listening on error detection. Similar to the present study, neither found significant results. Thornton compared two different groups and their ability to detect errors, one that listened while playing an instrument and the other that listened to a recording. Sheldon examined how listening to a melody multiple times affects a student's ability to detect errors. It is possible that the repeated listenings might have encoded the information into long term memory. This might have then conflicted with the error detection. The results of these studies combined with the present study suggest that error detection may not be easily taught through instruction.

Instead of instruction, past experience may be a bigger factor in the ability to detect errors. In the current study, past experience that was identified through the background questionnaire was a better predictor of error detection than type of instruction. Although not a direct research question of the current study, the raw data suggests this. This is congruent to the findings of Coveyduck (1998) who investigated the effect of singing on the intonation of beginning band instrumental students. Coveyduck reported significant results ($p < .05$) favoring the group which received instruction that included singing. However, the background

questionnaire identified students with prior voice experience and once they were eliminated from the study the results were no longer significant at the $p < .05$ level. Based on conclusions from Coveyduck and the current study, the role of past experience in music may be a more important factor in developing certain skills in music like error detection than type of instruction.

The nesting of groups may have also been a factor that caused the results to be non-significant. Nesting was necessary because the subjects were from two separate schools, two different grade levels and homogeneously grouped by instrument. The groupings were pre-determined prior to the study. A review of the data reveals that the sum of squares error (1012.341) and the mean square error (22.715) were both large indicating that one of the sources of variation had caused the treatment groups to have less sensitivity. Further review of the F values reveal which factors may have caused this. The F value for the *IMMA* was 2.229; the F value for the nested factor was 1.607; and the F value the treatment groups was .390. The F value for both the *IMMA* scores and the nesting of groups was large especially when compared to the F value for the treatment groups. The high values for the *IMMA* scores were used as a covariate thus controlling the possibility of it affecting the treatment factor. The F value for the nested factor was large but unlike tonal aptitude, it was not used as a covariate within the ANCOVA indicating that the nesting of groups had notable variability. In other words, the homogeneous groupings by school, grade level and instrument affected the treatment.

Audiation and singing on error detection skills.

The comparison of audiation instruction to singing instruction on the ability of students to detect errors did not yield significant results ($p > .05$), indicating that instruction which included singing was no more effective at developing error detection skill than instruction that included audiation. This suggests that audiation instruction may be a viable alternate technique to singing.

However, it is important to note that neither the *AG* nor the *SG* performed significantly better than the control group which suggest that neither singing or audiation instruction were effective in developing error detection skill.

The first part of discussing these findings is that audiation was not found to be an effective alternative to singing in the development of error detection skills, supporting the findings of Bennett (1994), Schlacks (1981) and Sandor (1984) who did not find significant results while investigating alternatives to singing instruction in instrumental music lessons. Bennett investigated if the use of humming would improve junior high school students' intonation accuracy on brass and woodwind instruments. No significant results were found and Bennett concluded that humming did not improve intonation accuracy of students. Schlacks examined the effect that vocalization had on the pitch accuracy of high school students. The experiment consisted of interval training, which differed among the three treatment groups. One group learned interval training through the use of the voice, the other through an instrument and the third through a combination of the voice and an instrument. No significant results were found among the treatment groups, however mean scores of the treatment group that received training with the combination of the voice and instrument were higher than the other treatment groups. Lastly, Sandor compared mouthpiece buzzing to singing on pitch accuracy. Sandor reported significant results favoring the group that had singing instruction and concluded that mouthpiece buzzing should only be used as a substitute for singing if singing instruction had been previously given.

The results of the current study coupled with the studies described above suggest that something about the physical use of the voice makes singing a superior technique to alternate methods in lieu of vocalization such as audiation, humming and mouthpiece buzzing. Again,

perhaps this is due to a student's past experience with singing. Students are exposed to singing both informally at home and away from school as well as formally in general music classes. Familiarity and practice with alternate techniques like audiation, humming and mouthpiece buzzing may be key to those techniques being effective.

A second interesting finding from the results of this study is that singing was not found to be an effective technique in developing error detection. This differs from findings seen in some earlier studies that suggest the use of singing is an effective methodology (Bernhard, 2003; Bloedel Beery, 1996; Elliott, 1974; Grutzmacher, 1987; Jones, 2003; Krubsack, 2006; Lee, 1996; MacKnight, 1975). Instead, the results of this study are congruent to findings by Smith (1984), who examined the use of singing instruction on the intonation of brass and woodwind students. Subjects in Smith's study were divided into two groups: a control group which performed exercises on their instruments without the use of the singing voice and a experimental group that vocalized exercises prior to performing them on their instrument. No significant difference was found between the two groups however, Smith did report significant differences ($p < .05$) in the intonation between brass and woodwind subjects favoring students who play woodwind instruments. The subjects in the current study were placed in homogenous groupings by instrument which ultimately separated them by brass and woodwind instruments. The grouping of instruments was one of the nested factors used for data analysis. As explained previously, the nested factor had a large F value indicating that there was high variability within the subgroups that made up the nesting factor. Based on the results of Smith's research, it would be interesting to investigate the differences between the error detection abilities of brass and woodwind players in the study. It may be that students who study brass or woodwind instruments learn differently. For example, students who play brass instruments may be more aware of the connection between

the ear and producing the correct note on an instrument because of the way brass instruments work. This may be different for woodwind players who could have a “push button” mindset when playing their instrument and only learn to associate a fingering to a written note instead of a musical pitch.

These findings, as well as the current study, suggest that audiation is not a better technique over singing in improving error detection scores of elementary band students. However, in the current study, it is interesting to note that singing was not significantly better than the audiation group nor the control group which, received no treatment.

Relationship of tonal aptitude to error detection skill.

An ANOVA was run on the total scores from all the subtests as well as each individual subtest of the *EDT*. Significant results were found on the total scores ($p = .021$) of the *EDT* and Test D ($p = .007$). No significance was found ($p > .05$) on Test A, Test B or Test C. The results of the ANOVA on the total scores and Test D support the findings of Bernhard (2003) who found positive correlations among level of tonal aptitude and ability to play by ear.

Bernhard concluded that aural abilities measured by an aptitude test were positively correlated to the ability to play by ear. In the current study, subjects classified as having high tonal aptitude performed better on the *EDT* which measured ability to detect errors. These findings suggest that students with higher tonal aptitude may have the ability to hear and detect errors which is a prerequisite to the skill of playing by ear.

Future Research

The purpose of this study was to compare the use of vocalization methods on beginning instrumental students' ability to detect tonal errors. The results from this study may help guide future research.

One of the limitations of this study was the possibility of the music aptitude or amount of musical experience having a skewed distribution among the treatment and control groups. Compounding the issue, subjects in this study were already nested in small groups according to instrument, grade level and school prior to the study. Tonal aptitude or amount of music experience could easily become contaminating factors if unevenly distributed among the treatment groups. It would be of interest to run the experiment again with a different pool of subjects in a situation where they are not already set in predetermined groups. If that situation is not possible, the research design should include past music experience as an additional covariate.

The factor of experience was a bigger predictor of error detection skills than tonal aptitude. This was apparent from examining the raw data and supported by the research of Bernhard (2003), Coveyduck (1998), Elliot (1974), Eu (1976), Geringer (1983) and Kuhlman (1996) each of whom concluded that past musical experience could positively affect student musical performance. In fact, results of the current study suggest that audiation or singing instruction does not facilitate a student's ability to detect tonal errors. Instead, the ability to detect errors may be more due to past experience than type of instruction. It would be of interest to replicate the experiment but further investigate the role musical experience has with error detection skill.

Future researchers who study within an elementary band setting may want to employ a Nested ANCOVA model for the data analysis. In the present study, nesting was necessary

because of the subgroups formed. Subjects were located in two different schools, two different grade levels and the homogeneously grouped by instrument. This may be a typical situation for elementary band programs. The Nested ANCOVA will report variations within the subgroups leading to more accurate data analysis.

Perhaps the biggest limitation of the study was the length of the treatment period. The treatment period was only eight weeks with an additional two weeks used for testing of the *EDT* making the total length of the experiment ten weeks. The length of the study was dictated by the school calendar. If the treatment period were extended, both treatment and testing would be interrupted by school holidays. Replicating the study to run a full academic year would likely yield different results. This is apparent through examination of the means from the *EDT* because they fell in a linear order as hypothesized. The mean scores for treatment groups were similar and higher than the mean score the *CG*.

Summary

Based on results from the present study, instruction that includes audiation techniques is not more effective ($p > .05$) than instruction that includes singing or traditional instruction that does not include audiation or singing. In terms of singing instruction, this study contradicts past research in which singing was found to be an effective technique in developing music achievement. Audiation instruction was also found to be similar to singing instruction in the ability to detect errors. This finding suggests that audiation may be effective as an alternate technique to singing in terms of error detection ability. This can only be suggested and not generalizable to populations outside the study because the means of the two treatment groups were similar and higher than the control group but not at a significant level.

Also based on information from the mean scores, teachers who instruct beginning instrumental students may want to consider using the *Rote Song Procedure* outlined in this study. The procedure was used with both treatment groups which had higher mean scores than the control which did not follow the procedure. Again, this is not generalizable to populations outside the study because the difference in the means was not at a statistically significant level.

Lastly, it can be concluded that level of music aptitude affects the ability to detect errors. In the present study, subjects with high tonal aptitude were better at the task of identifying melodic errors than subjects that had medium or low tonal aptitude.

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Appendix A
Site Permission Letters

Richard Beckman
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rbeckman@chclc.org

Mr. Robert Homer
Principal
Sharp Elementary School
Old Orchard Road
Cherry Hill, NJ 08003

June 10, 2013

Dear Mr. Homer,

I am writing to request permission to conduct the research for my Doctoral Dissertation in your school. Specifically, I would like permission to work with the band and orchestra students I presently have in my schedule. The research for the dissertation will take place over a 10-week period starting in the Fall. The research will involve different approaches to make a melody familiar to students. All students involved in the study will be required to complete a survey and several short assessments. Instruction for both the control and treatment groups will be the same however the treatment groups will receive additional techniques to become familiar with the melody.

The proposal for the research was submitted to the Rutgers Institutional Review Board and was granted exempt status. If you have any questions, concerns or require further explanation, please do not hesitate to contact me at the above address. I would like to thank you in advance for your consideration of my request.

Sincerely,

Richard Beckman

Richard Beckman
Sharp Elementary School
Cherry Hill, NJ 08003
(856) 424-1550
rbeckman@chclc.org

Dr. John Cafagna
Principal
Bret Harte Elementary School
1909 Queen Anne Drive
Cherry Hill, NJ 08003

June 10, 2013

Dear Dr. Cafagna,

I am writing to request permission to conduct the research for my Doctoral Dissertation in your school. Specifically, I would like permission to work with the band and orchestra students I presently have in my schedule. The research for the dissertation will take place over a 10-week period starting in the Fall. The research will involve different approaches to make a melody familiar to students. All students involved in the study will be required to complete a survey and several short assessments. Instruction for both the control and treatment groups will be the same however the treatment groups will receive additional techniques to become familiar with the melody.

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Sincerely,

Richard Beckman

Richard Beckman
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Mr. Ed DePalma
Acting Supervisor of Music
Cherry Hill Public Schools
Woodcrest Elementary School
400 Cranford Road
Cherry Hill, NJ 08003

June 10, 2013

Dear Mr. DePalma,

I am writing to request permission to conduct the research for my Doctoral Dissertation in Sharp and Bret Harte schools. Specifically, I would like permission to work with the band and orchestra students I presently have in my schedule. The research for the dissertation will take place over a 10-week period starting in the Fall. The research will involve different approaches to make a melody familiar to students. All students involved in the study will be required to complete a survey and several short assessments. Instruction for both the control and treatment groups will be the same however the treatment groups will receive additional techniques to become familiar with the melody.

The proposal for the research was submitted to the Rutgers Institutional Review Board and was granted exempt status. If you have any questions, concerns or require further explanation, please do not hesitate to contact me at the above address. I would like to thank you in advance for your consideration of my request.

Sincerely,

Richard Beckman

Richard Beckman
Sharp Elementary School
Cherry Hill, NJ 08003
(856) 424-1550
rbeckman@chclc.org

Dr. Maureen Reusche
Superintendent of Schools
Cherry Hill Public Schools
Malberg Administration Building
45 Ranoldo Terrace
Cherry Hill, NJ 08034

June 10, 2013

Dear Dr. Reusche,

I am writing to request permission to conduct the research for my Doctoral Dissertation in Sharp and Bret Harte schools. Specifically, I would like permission to work with the band and orchestra students I presently have in my schedule. The research for the dissertation will take place over a 10-week period starting in the Fall. The research will involve different approaches to make a melody familiar to students. All students involved in the study will be required to complete a survey and several short assessments. Instruction for both the control and treatment groups will be the same however the treatment groups will receive additional techniques to become familiar with the melody.

The proposal for the research was submitted to the Rutgers Institutional Review Board and was granted exempt status. If you have any questions, concerns or require further explanation, please do not hesitate to contact me at the above address. I would like to thank you in advance for your consideration of my request.

Sincerely,

Richard Beckman

Appendix B

Parental Consent Form and Student Assent Form

Consent Form

The effects of audiation on the error detection abilities of fourth and fifth grade instrumental students

Rich Beckman
Mason Gross School of the Arts

Dear Parents,

I am a currently a graduate student in music education at Rutgers University. In order to complete my degree requirements, I am required to conduct a research study. As a teacher at Bret Harte and Sharp School, I would like to request permission for your child to participate in the study. I will briefly explain the study to the children who have returned this permission slip, and also ask for their agreement to participate. The purpose of the research is to compare vocalization methods on a students' ability to detect tonal errors.

The study will last ten weeks (ten lessons) and take place during your child's regularly scheduled lesson time. During the study, students who participate will be asked to fill out a brief questionnaire and identify errors in musical notation while they are listening to a recording. If your child indicates at any time that they want to stop filling out the questionnaire or the test, they can do so and they will be thanked for their participation.

There are no known risks to your child for participating in this study, and your child will not benefit directly from participation. Their grades will not be affected in any way, whether or not they participate in the study. However, the data collected may be helpful to music educators and lead to the improvement of instruction in elementary instrumental music lessons.

This research is confidential/anonymous. Confidential means that the research records will include some information about your child, such as age and gender. I will keep this information confidential by limiting individual's access to the research data and keeping it in a secure location. I, as the researcher and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the data, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated. All data from the study will be kept for at least three years.

If you have any questions about the research, you may contact me at (609) 970-5365 or through email at rbeckman@chclc.org. If you have any questions about your child's rights as a research subject, you may contact the IRB Administrator at:

Rutgers University, the State University of New Jersey
Institutional Review Board for the Protection of Human Subjects
Office of Research and Sponsored Programs
3 Rutgers Plaza
New Brunswick, NJ 08901-8559 Tel: 848 932 4058
Email: humansubjects@orsp.rutgers.edu

Subject's Initials _____

Your child's participation in this study is completely voluntary. Please sign and return the attached permission slip if you are willing to have your child participate. Your support is greatly appreciated. You will be given a copy of this form to keep.

Sincerely,

Rich Beckman

Student name: _____

School: (Circle one) Bret Harte Sharp

My child listed above has permission to participate in the research study *The effects of audiation on the melodic error detection abilities of fourth and fifth grade instrumental students* that will be conducted by Rich Beckman.

Signature of Parent or Guardian _____

Date _____

ASSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

Investigator: Mr. Rich Beckman, Rutgers University

Study Title: The effects of audiation on the melodic error detection abilities of fourth and fifth grade band students.

This assent form may contain words that you do not understand. Please ask me or your parent or teacher to explain any words or information that you do not clearly understand before signing this document.

1. Mr. Beckman is inviting you to take part in his/her research study. Why is this study being done?

Mr. Beckman is completing a Doctorate in Music Education.

He wants to find out the best ways to help students learn songs to play on their instruments.

2. What will happen:

First you will take a short test with your classroom music teacher . You will also take a short questionnaire about your musical background. You will then learn new songs during your regular instrument lesson with Mr. Beckman. You will learn the songs by listening, singing or audiating. You will NEVER have to sing by yourself in front of your peers but instead in a group. After 8 weeks, you will take a simple test to measure how well you know a song that Mr. Beckman teaches you. Other than regular practice, you do not need to do any extra work!

3. What does it cost and how much does it pay?

You do not pay to take part of this study and you participation is voluntary.

4. There are very few risks in taking part in this research, but the following things could happen:

Probably: Nothing bad would happen.

Maybe: Your answers would be seen by somebody not involved in this study. I will do my absolute best to keep all your answers private. Your answers will be kept locked up. Your name will not appear on the answer sheets; I will use a code number instead.

Very unusual: You could be upset by your performance. If this should occur, remember that your identity is kept confidential and you may ask to stop participating in the study at any time.

5. Are there any benefits that you or others will get out of being in this study?

All research must have some potential benefit either directly to those that take part in it or potentially to others through the knowledge gained. The only direct benefit to you may be the enjoyment of training to become a better musician. The knowledge gained through this study may allow me (and other music educators) to develop more effective training programs to improve instrumental music lessons. **It's completely up to you!** Both you and your parents have to agree to allow you to take part in this study. If you choose to not take part in this study, I will

honor that choice. No one will get angry or upset with you if you do not want to do this. If you agree to take part in it and then you change your mind later, I will understand. It's always your choice!

6. **CONFIDENTIALITY: I will do everything we can to protect the confidentiality of your records.** If I write professional articles about this research, they will never say your name or anything that could give away who you are. I will do a good job at keeping all my records secret by following the rules made for researchers.
7. **Do you have any questions?** If you have any questions or worries regarding this study, or if any problems come up, you may contact me at:
Sharp Elementary School
300 Old Orchard Road
Cherry Hill, NJ 08003
856-424-1550
rbeckman@chclc.org

You may also ask questions or talk about any worries to the Institutional Review Board (a committee that reviews research studies in order to protect those who participate). Please contact the IRB Administrator at Rutgers University at:
Rutgers University, the State University of New Jersey
Institutional Review Board for the Protection of Human Subjects
Office of Research and Sponsored Programs
3 Rutgers Plaza
New Brunswick, NJ 08901-8559
Tel: 848-932-0150
Email: humansubjects@orsp.rutgers.edu

Your parent or guardian will also be asked if they wish for you to participate in this study. You will be given a copy of this form for your records.

Please sign below if you assent (that means you agree) to participate in this study.

Signature _____ Date _____

Name (Please print): _____

Investigator's Signature: _____ Date: _____

Appendix C

Student Experience Questionnaire

Student Questionnaire

Please read each question and statement carefully.

Circle YES or NO to indicate if the statement does or does not describe you.

Name _____

Age _____

Teacher _____

Grade _____

- | | | |
|----------------------------------------------------------------------------------------------------------------------------|-----|----|
| 1. I have taken piano lessons for at least one year. | YES | NO |
| 2. I am taking piano lessons this year. | YES | NO |
| 3. I played a musical instrument for at least one year <i>before</i> taking lessons in school (not including the recorder) | YES | NO |
| 4. If you answered yes to question 3, is it the same instrument you are playing now? | YES | NO |
| 5. I have taken voice lessons for at least one year. | YES | NO |
| 6. I am taking voice lessons this year | YES | NO |

Appendix D

Songs Used for Treatment

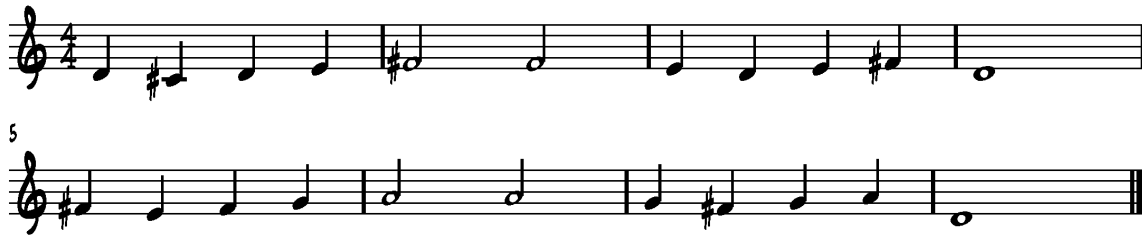
Song #1 Au Claire De La Lune



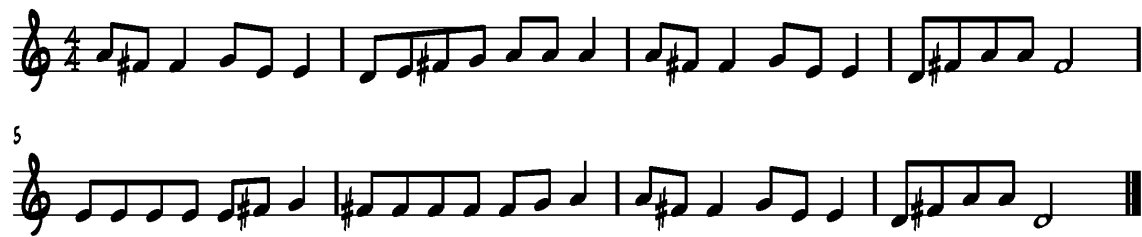
Song #2 Morning Dance



Song #3 Sweetly Sings the Donkey



Song #4 Lightly Row



Song #5 Crusader's March



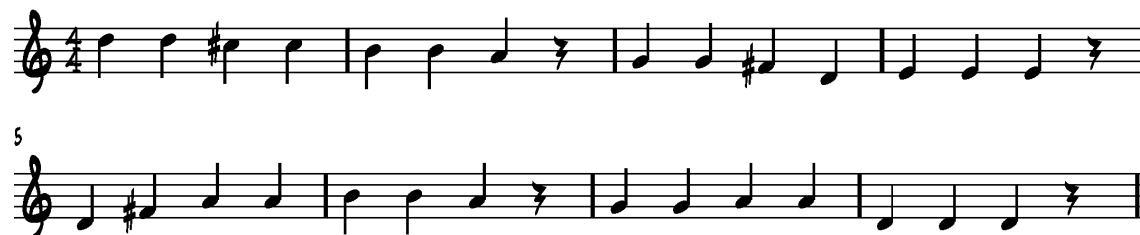
Song #6 Mary Ann



Song #7 Jim Along Josie



Song #8 Song for Christine



Appendix E

Error Detection Test Melodies/Response Sheets

Code Number _____

Listening Melody

Song A - Flute



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number _____

Listening Melody

Song B - Flute



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number _____

Listening Melody

Song C - Flute



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number _____

Listening Melody

Song D - Flute



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song A – Clarinet/Trumpet



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song B – Clarinet/Trumpet



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song C – Clarinet/Trumpet



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song D – Clarinet/Trumpet



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song A – Alto Saxophone



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song B – Alto Saxophone



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song C – Alto Saxophone



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song D – Alto Saxophone



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song A – Trombone/Baritone



How do the notes of this melody sound to you:

_____ All right

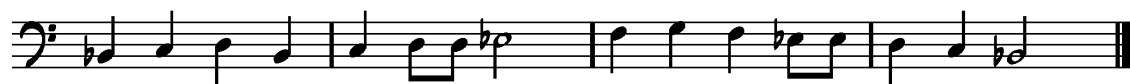
_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song B – Trombone/Baritone



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song C – Trombone/Baritone



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song D – Trombone/Baritone



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song A - Tuba



Code Number_____

Listening Melody

Song C - Tuba



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Code Number_____

Listening Melody

Song D - Tuba



How do the notes of this melody sound to you:

_____ All right

_____ Wrong, circle wrong note(s)

_____ Not Sure, circle note(s) you think might be wrong

Appendix F

Post Hoc Tests for Error Detection Test

Table 13

Tukey HSD Comparison Test for Level of Tonal Aptitude on Total Score of EDT

Tonal Aptitude by Level		Mean Difference	<i>SD</i>	<i>p</i>
H	L	3.44	1.361	.035*
	M	2.72	1.073	.034*
L	H	-3.44	1.361	.035*
	M	-.72	1.116	.794
M	H	-2.72	1.073	.034*
	L	.72	1.116	.794

Note. * $p < .05$

Table 14

Games-Howell Comparison Test for Level of Tonal Aptitude on Song C

Tonal Aptitude by Level		Mean Difference	<i>SD</i>	<i>p</i>
H	L	2.19	.635	.004**
	M	1.16	.459	.039*
L	H	-2.19	.635	.004**
	M	-1.02	.582	.203
M	H	-1.16	.459	.039*
	L	1.02	.582	.203

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

Table 15

Games-Howell Comparison Test for Level of Tonal Aptitude on Song D

Tonal Aptitude by Level		Mean Difference	<i>SD</i>	<i>p</i>
H	L	.18	.287	.801
	M	.63	.229	.022*
L	H	-.18	.287	.801
	M	.45	.281	.263
M	H	-.63	.229	.022*
	L	-.45	.281	.263

Note. * $p < .05$