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The effect of singing on the intonation of middle school flute players.

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THE EFFECT OF SINGING ON THE INTONATION OF MIDDLE SCHOOL FLUTE PLAYERS

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A Thesis Approved on

April 25, 2012

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DEDICATION

This thesis is dedicated to my parents

Neil and Debra Mattingly

who have always supported both my love of music

and of teaching in whatever ways they could.

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ABSTRACT

THE EFFECT OF SINGING ON THE INTONATION

OF MIDDLE SCHOOL FLUTE PLAYERS

Ashley M. Mattingly

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The purpose of this study is to measure the effect of listening to and singing a tuning pitch on a flute player's intonation. This investigation determines if these two variables—hearing and singing—will have an effect on playing a single pitch, particularly among beginning flutists. Participants ($N = 33$) were middle school flute players with between one and four years experience playing their instrument. Participants were sampled from a major school district in the Southeast. Participants were asked to tune a control instrument to a pre-recorded Bb chord and a single Bb pitch as played by an electric piano. After resetting the instrument to the original position, participants heard the same chord and pitch but they were then asked to sing the Bb note on the neutral syllable "la" before adjusting the flute and playing a second time. Results were measured in cents using computer. The differences in intonation between the tuning of the Bb without singing showed no significant difference from when the participants sang the pitch before tuning. Suggestions for future research applications are included.

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CHAPTER ONE

INTRODUCTION

Purpose of the Study

Skills in intonation are one of the most important tools in a musician's arsenal. When starting beginning musicians, intonation skills are often within the top three skills they begin to develop (the other two being technique and tone). A musician with poor intonation will sound much like the musician with poor technique, who plays many wrong notes. Thus, it is important for the music educator to discover and use what strategies best assist the beginning musician in developing good intonation skills. This study examines the effect of vocalization on middle school students in the process of tuning a flute.

Making music is the core of a solid music education: it could be argued that there is no point to music education if the students never make music. Part of the skills developed should include the ability to sing in tune and to recognize pitch direction changes. It is with these skills that students really begin the process of learning to play in tune. Ideally, these skills would be learned in the general music classroom. However, due to budget cuts and time restrictions, music is not always a guaranteed part of an elementary school education. Students may not begin learning these skills until their first year in an instrumental ensemble.

It is common practice in many band rooms—from middle school to college—to hear a reference tuning pitch given often by the tuba, clarinet, or oboe and to hear the

ensemble to tune their instruments to this note. It is also becoming more common for the ensemble to sing or hum this reference pitch on a neutral syllable such as 'la' before tuning their instruments. Vocalization also takes place in the music classroom when the conductor has the ensemble to sing a particular phrase or chord in the literature before playing it on instruments. Although vocalization in the performing ensemble classroom is becoming more common, there have been few studies that show the legitimacy of this exercise to improve intonation.

Hypothesis

It is my hypothesis that vocalization in the band classroom is beneficial to beginning musicians as it combines previously learned skills of singing in tune with the new skill of playing a wind instrument. It is further hypothesized that those students who are able to sing in tune are better able to play in tune since they would have a better sense of internal pitch.

Many factors contribute to the overall intonation of a particular instrument. Room temperature, instrument quality, and performance ability all have an effect on whether or not a performer is in tune for a particular performance. However, it is my hypothesis that students who are able to internally hear a pitch center from a reference tone and produce this through singing the pitch will be better able to tune their instrument than those who are unable to do so. This study will focus on middle school flute students. By sampling middle school flute students and having them to tune a flute both with and without singing, the current investigation will explore if vocalizing before

tuning has a significant effect on a student's intonation. Three specific hypotheses are outlined below.

1. Research Hypothesis, H_1: Singing before tuning has a positive effect on the individual's ability to tune a flute.

Null Hypothesis, H_0: Singing before tuning has no effect on the individual's ability to tune a flute.

2. Research Hypothesis, H_2: An incorrectly sung pitch will have a negative effect on the individual's ability to tune a flute.

Null Hypothesis, H_0: An incorrectly sung pitch will have no effect on the individual's ability to tune a flute.

3. Research Hypothesis, H_3: There is a positive relationship between how long a student has studied music and their ability to sing in tune.

Null Hypothesis, H_0: There is no relationship between how long a student has studied music and their ability to sing in tune.

Significance of the Study

Although vocalization in the band classroom is becoming more widespread, few studies have been undertaken to estimate the effect that it is having on intonation. If there is a positive effect from vocalization on the intonation of developing musicians, then this technique of teaching intonation and aural skills should be more highly used. Many variables affect how well a student is able to tune an instrument, and singing before tuning may be a universal method to assist in greater intonation accuracy.

CHAPTER TWO

REVIEW OF LITERATURE

The topic of intonation has been investigated by many researchers and most often in relation to performance (Geringer, 1978; Geringer & Worthy, 1999; Kantorski, 1986; Karrick, 1998). As part of intonation research, studies have often focused on aural skill training and the abilities of young musicians. Additional studies have focused on intonation in the context of performances.

Skills in intonation are often developed in beginning musicians and refined for as long as the musician continues to perform. As music is a purely aural art, intonation skills are one of the most important skills a musician will learn. Aural skill training is essential to the development of good intonation, but more research is needed to discover what teaching methods help to develop intonation skills in developing musicians.

Intonation Perception Studies

Intonation perception studies, as well as performance studies, have generally revealed that humans perceive sharply tuned music to be more pleasing and "correct" than music tuned to be flat. For example, Geringer (1976) asked undergraduate and graduate music students ($N = 60$) to modulate the pitch of ten orchestral works with a variable speed tape recorder until they sounded in-tune. The participants were able to modulate the pitch levels within the range of an augmented fourth. It was found that the

participants preferred sharply tuned recordings to the original recordings by a ratio of 3.68:1.

Similarly, Karrick, Morrison, and Yarbrough (1995) investigated this tendency toward playing sharp in relation to intentionally mistuned instruments. Participants were 197 beginning and intermediate wind players who had received between one to four years of music instruction. Although there were no significant differences in intonation preferences when participants knew the direction of mistuning, overall intonation accuracy was greater in the musicians who had been studying their instrument for several years. Also, there were a greater number of perceived sharp responses in the musicians who had been studying for four years compared with students who had only received one year of music instruction. Younger musicians tended to play below the given pitch.

In a related study, 120 string players (60 high school students and 60 college students/professionals) were asked to tune the A string on their instrument to a sounding pitch that was either in-tune, 25 cents sharp, or 15 cents flat (Geringer & Witt, 1985). The participants were instructed that the pitch may or may not be accurate, and they were to tune their instrument to an A they felt was correct. After tuning, the participants were asked to describe the pitch of the tuning note: responses were recorded as flat, in-tune, or sharp. Results indicated a significant difference in pitch deviation relative to all 3 pitch stimuli ($p < .001$). High school students tuned lower in pitch than the college/professional participants to both the sharp (10 cents) and flat (5 cents) stimuli. Participants in all three conditions generally showed a preference for tuning sharply, similar to other studies of the same nature.

Octave and timbre may have an effect on the way that musicians perceive intonation, which would affect their ability to tune to a given pitch (Byo, Schlegel, & Clark, 2011). Four tuning stimuli—a $B\flat_4$ sounded by flute, oboe, and clarinet and $B\flat_2$ sounded by tuba—were played for high school wind players ($N = 72$). Participant responses were more out of tune with the tuba stimulus than with the wind instrument stimuli, although there was no difference in the distribution of in-tune, sharp, and flat responses across the tuning stimuli. Most of the participants (82%) reported that the tuba was most often used to tune in their school bands. However, they performed best when the flute and oboe were tuning references, indicating their preference for those timbres.

Powell (2010) synthesized research done in intonation research for the past several decades and concluded that there is no consistent relationship between the intonation perception (the ability to hear and identify intonation problems) and the ability to play in-tune. Those students who can accurately identify intonation errors are no more or less likely to be able to perform more in-tune on their instruments. He suggests that the difficulties in playing in-tune are less that the student isn't able to hear the problems, but that they have difficulty changing their embouchure or maintaining the air support needed to correct the pitch errors.

Hamann, Lauver, and Asher (2006) examined whether students' perceptions of their own tuning abilities were correct. Participants were 60 middle school string players who had been provided instruction in tuning for two years prior to the study. They were asked to identify their instrument, how long they had studied, grade level, and how they rated their ability to tune their instrument. It was found that students' perceptions of their own tuning abilities were correct. Students who were self-rated as having good tuning

abilities tended to score lower (less tuning cents difference from the actual pitch) than those who rated themselves as fair or poor. This relates to Powell's research in that students who are able to identify intonation problems are not more likely to actually perform in-tune. More research is needed to see if students can accurately identify their own intonation problems after playing and after listening to their own performances.

Intonation and Accompaniment

Studies have also been undertaken to estimate the effect of accompaniment on a performer's intonation. For example, Karrick (1998) examined selected intervals in a duet where the musician performed one line and a computer partner performed the other electronically. Participants ($N = 16$) were experienced wind instrumentalists (8 professionals, 8 advanced students). Participants were asked to record performances of both duet parts with the computerized duet partner. Results indicated that the musicians were more in-tune when performing the melody of the duet than the accompaniment. Both advanced students and professionals tended to play sharply when playing out of tune regardless of the music performed. Interestingly, results suggest that the tendency towards playing music sharply could indicate a preference for tuning sharp.

In a similar study, university-level woodwind players ($N = 27$: 9 flute, 9 saxophone, 9 clarinet) recorded unison duets with pre-recorded melodies played by a flute, saxophone, or clarinet (Ely, 1992). After this performance task, the participants were asked to listen to the duets they had recorded and to analyze the tone pairs to identify which pairs were out of tune. The study found that when playing with the pre-recorded melody, these musicians consistently played below pitch. They played more

below pitch (more flat) when playing with the saxophone melody (regardless of what instrument was played), and they played the least flat when playing with the flute melody. This tendency to play below pitch stands in contrast to the 1998 Karrick study. In the listening portion of the Ely study, it was found that there was no significant difference on the participants' ability to detect the out of tune pairs based on the instrument timbres in the duets. It was found that the participants were better at hearing intonation problems in unlike timbres than in like timbres.

Ballard (2011) examined the effect of accompaniment in various tuning standards (equal temperament, Pythagorean, and just intonation) on the intonation perception and performance of undergraduate wind instrument majors ($N = 60$). In one phase of the study, the participants were asked to perform the first phrase of the *Star Spangled Banner*. The provided accompaniment was tuned to one of the three tuning scales, and one trial was run unaccompanied. In a second phase, participants were asked to sing on a neutral syllable the same phrase, with each note as a half note. It was also performed both accompanied by the three different tuning standards and one unaccompanied condition. It was found that the vocal performances were far less accurate than the instrumental performance. It was also found that the participants performed significantly ($p < .05$) better with the equal tempered stimuli than with the Pythagorean or just intonation stimuli. In the instrumental performances, the unaccompanied condition performances were similar to the equal tempered condition performances in intonation results.

Intonation and Tone Quality

Research in the area of tone quality and intonation has indicated that tone can have a significant impact on how intonation is perceived in performance (Madsen & Geringer, 1976). It was also found that participants preferred sharp versus in-tune responses. Additional results indicated that preference for tone quality was not significant when the performance was accompanied. A replication and extension study continued to support the research that in-tune and sharp performances were preferred by listeners, but that performances with good tone quality were consistently ranked higher than those with bad tone quality (Geringer, Madsen, & Dunnigan, 2001). Geringer and Worthy found that a "darker" trumpet tone quality was perceived to be flatter intonationally while "brighter" trumpet tone quality was perceived to be sharper, regardless of the actual intonation of the pitch (1999).

As suggested by several studies, accompaniment can also affect the intonation of performers (Karrick, 1998; Geringer, Madsen, & Dunnigan, 2001). Several studies have been undertaken to estimate the value of accompaniment in a performer's intonation. In one study, college-aged string players ($N = 48$) were found to perform significantly sharper ($p < .05$) in the high registers when playing ascending and descending tetra-chords with accompaniment, but performances in both the upper and lower registers were typically sharp (Kantorski, 1986). Similarly, Geringer (1978) found that both perception of intonation and intonation performance of scales were more accurate when accompanied.

In a related study, Madsen (1966) investigated the effect of scale direction on the pitch accuracy of five groups of musicians: elementary school students, high school

students, and undergraduate music majors emphasizing in vocal, piano, or violin performance ($N = 40$). Participants were asked to sing unaccompanied C and D scales both ascending and descending on a neutral syllable. The participants were divided into four treatment groups ($n = 10$) and assigned a scale order to prevent any deviation due to the order effect. It was found that all participants performed with greater pitch acuity when descending the scale ($p < .01$). It was also found that the cent deviation when ascending the scale was four times as great as when descending the scale, regardless of treatment and comparison between experimental and control conditions (23,921 cent deviation ascending versus 6,058 cent deviation descending). The results of the Madsen study are similar to the 1978 Geringer study in that intonation accuracy may be greater when accompanied.

Audiation and Intonation

Music educator Edwin Gordon, coined the term "auditation" to describe the process of the brain giving meaning to musical sounds and signals (2007). A person who is audiating is "assimilating and comprehending" music they have heard performed, whether recently or in the past. Many music educators may be teaching audition, though they may not name it as such. In the process of fostering audition, educators use intonation and inner-hearing in their classrooms regularly. In the instrumental setting, the student must use this music memory as a source to match a pitch. This might be analogous to beat elimination, described below, in that the student is using a reference tone to tune their own pitch. Teaching intonation through this approach would seem to be a more effective way to teach intonation because a physical reference pitch is not

available every time that a musician performs. The student must remember the pitch without it physically being present. By audiating the pitches that they are about to play—internally hearing what they want to produce on their instrument—a musician can play with better intonation even when there are no other simultaneous musical sounds.

Other music educators have continued on the work of Gordon in relation to specific instruments, especially brass instruments. Whitener (2007) describes the process of learning to play a brass instrument as "aural-mental" because it involves the ability to "prehear" the note before playing. He teaches brass students to learn this process through singing on solfegé. Singing in solfegé helps to fix pitches in the mind so that a clear picture of the note can be sent to the mind. Whitener states that the most common difficulty that brass students have is that they allow the instrument to determine the intonation rather than controlling it themselves. Although some notes require physical mechanical adjustments to the instrument, most intonation issues can be taken care of through embouchure, vowel formation, and air pressure. When the musician has studied solfegé and is able to sightsing, they are able to audiate the pitches to be played, creating better intonation.

Teaching Intonation

There are various methods used to teach intonation to beginning musicians. The most popular, although possibly least effective method, is showing the student an electronic or strobe tuner and having them to play until the tuner reads that note as "in-tune." Lisk states that using a strobe tuner actually causes students to "turn off" their ears since the tuner takes away their role in making musical decisions about their intonation

(2004). He advocates using the strobe tuner to find a particular instrument's pitch tendencies but not to use it to make musical decisions. Another method is teaching beat elimination, where the musician listens for the clashing of sound waves in two notes (perfect intervals of unison, octave, and fifths; also in thirds and triads) and tunes the instrument by hearing and eliminating those beats (Miles, 1972).

The beat elimination method would seem to be a superior method to teaching intonation since the student is aurally and physically involved in eliminating the clashing beats rather than receiving the "answer" directly from a tuner. In essence, educators using the "beat elimination" method are teaching audiation and vocalization. The student is encouraged to "hear" the pitch inside his head after hearing a reference tone, to play the pitch on their instrument, and to consolidate those two tones (the physical tone they create and the audiated or internalized tone). After audiation, vocalization may be added when the student hums or sings the remembered note, comparing the two notes. This method also seems superior to the tuner method since it requires the musician to develop listening skills between their own sound and others.

Pasqua (2001) developed and tested a method for developing intonation attentiveness and performance skills in high school instrumentalists. He had the treatment group (n = 28) to follow an instructional process that included ten sessions of tuning activities for six months. The treatment activities included adjusting when sharp or flat to a given pitch, tuning in intervals of fourths and fifths, and adjusting to both sharp and flat pitches. The control group (n = 19) continued as usual with their normal ensemble and lesson activities. During a pretest, both groups had the same mean score

on an intonation test ($M = 93$). During the posttest, the treatment group had significantly ($p < .0005$) better mean scores in both tuning accuracy and in the time it took to tune.

Morrison, Montemayor, and Wiltshire (2004) examined the effect that recorded models have on improving intonation and other musical performance elements of an ensemble. Three middle school/junior high bands and two high school band included professional recordings as part of their preparation of selected single-movement concert works. The models were played once a week in their entirety, and on another day each week, the director would select a section to play that corresponded to that day's rehearsal goals. Students were given surveys every week to indicate how they felt they were progressing, both personally and as an ensemble, on both the model pieces and music they were learning with no model. The surveys were both open response and Likert-scale responses. It was found that there was no significant difference in ensemble achievement between model and non-model pieces for any grade level for any of the performance criteria. While it may be beneficial for students to hear professional model recordings, simply hearing in-tune performances did not seem to affect the students' views on their own ensemble intonation.

In his article "The Rehearsal—Mastery of Music Fundamentals," Lisk encourages students to play scales to learn intonation (1998). He states that intonation problems result when students hear their pitches out of a harmonic context. If the students are able to hear the melodic and harmonic relationships in a key, they'll begin to play more in-tune because they'll see intonation in a greater perspective than a single tuning pitch. Lisk also uses a "Balance, Blend, Intonation" triad to teach students to listen within an ensemble. By teaching the students specifically to listen to their volume (balance) and

tone quality (blend), he gives the students active responsibility to adjust for better intonation. If the student is able to say they are playing with good balance and blend, but that their sound is still "out" of the ensemble, the student knows to check for intonation problems with their playing.

In his article "The Mysterious World of In-Tune Playing," Lisk identifies other ways to have students be responsible for their intonation by being active listeners (2004). He supports a "Target Tuning" approach where students listen up the section to the principal player, who is listening to the fundamental pitch. This gives each student a specific direction in which to tune, making them each responsible for their intonation. Junkin also states that his college bands use the same target tuning approach. He maintains that "it is the responsibility of the principal players to get in tune with each other and it is every section members' job to get in tune with their principal player" (2008). Lisk also teaches students to listen for blend within the sound pyramid: the lowest voices are on the bottom of the pyramid, which builds gradually to the top by adding higher voices. Using the sound pyramid works for balance in all dynamic registers—a piccolo playing forte should never be the same as a tuba playing forte.

The American School Band Directors Association (ASBDA) has published a curriculum guide as to what should be expected of band students of each level (basic through advanced) in each of the nine music education standards defined by the National Association for Music Education (1997). It states that Level One musicians (beginners) should be able to perform with a characteristic tone quality in the middle register, and to be able to "perform with other instrumentalists to achieve an ensemble sound characteristic of a Grade I level of performance." Although it does not specifically

mention intonation in the Level One curriculum for performing on instruments, previous research noted above shows good tone quality to be an important part of having good intonation. Good tone quality, combined with good intonation, is essential to achieving a good ensemble sound.

Beginning in Level Two, the ASBDA specifically mentions intonation. Students should be able to "adjust the pitch of his/her instrument to a given standard during actual performance and with the use of a tuning device." It continues to reiterate the tone quality standards from level one, but adds that good tone quality should be present in the middle register and at a middle dynamic range. The ASBDA continues to increase the standards of intonation and tone quality through the advanced level (Level Four). From this curriculum guide, it can be surmised that intonation skills, along with tone quality skills, should begin to be developed as soon as musicians are introduced to playing their instruments.

Director of Bands Emeritus at Florida State University, James Croft, states that tuning a large ensemble is often a waste of time: small pitch variations (up to 20 cents) are not going to be recognizable with a 100 member ensemble (2008). However, if you were to pull any five musicians and have them to play together, the pitch differences would instantly be noticeable. Because tuning becomes more critical in smaller ensembles, Croft required all his new undergraduate students to play in chamber ensembles for the purpose of fine-tuning their acute listening skills. This approach of further developing acute intonation skills can be used for musicians of all ages.

As the 2010 Powell research synthesis concluded, it is not always because of an inability to perceive pitch problems that students play out of tune. Many times,

instrument tendencies make it difficult to play a particular pitch in tune. Woolery (2011) suggests that clarinet players be taught to tune three notes: one short, one medium, and one long tune note. Because the instrument has different tendencies in each of these situations, tuning each of them and making an adjustment that corrects the overall instrument pitch is more likely to help intonation than tuning to just a single pitch, which when corrected, may pull other notes more out of tune.

In a study regarding novice and expert teacher rehearsal behaviors, Berkley (2011) found that expert teachers were more likely to have intonation and tone as performance targets than novice teachers. The novice teachers were more likely to focus on articulation and tempo. Both expert and novice teachers tended to use rehearsal techniques that involved providing information more than modeling or positive/negative feedback. The teachers mentioned in this chapter are highly regarded music educators with many years of experience. The Berkley study supports the advice of the master teachers mentioned above as they also focus highly on intonation in their ensembles.

Singing and Intonation

Further research is needed linking the relationship between singing and performance intonation. One non-performance study involved an experimental ($n = 15$) and a control group ($n = 15$) that were given identical training in instrumental methods and conducting (Sheldon, 1998). Participants ($N = 30$) were undergraduate instrumental music education majors. The experimental group was given 50 minutes of training weekly in sight-singing and ear training. As a performance task, both groups were asked to detect rhythm and pitch errors in one-, two-, or three-part homorhythmic and

polyrhythmic examples. Those that received the extra training (the experimental group) were more accurate in identifying pitch errors and were less likely to assume errors that were not there compared with the control group. In a similar study, Wuttke (2011) also found that activities involving aural-based tuning strategies (tuning intervals and chords) lead to higher intonation scores.

Demorest (2001) examined pitch-matching performance abilities of junior high boys and their ability to perceive intonation problems. Participants ($N = 34$) were enrolled in vocal or general music classes at school. In a performance task, the students were asked to match a series of pitches from a prerecorded male vocal model with no vibrato. Students were assigned pitch sets based on their comfortable singing range, as determined through teacher recommendation and having the students to sing a familiar song for the researcher prior to the study. The students were divided into groups of "certain" or "uncertain" singers based on their performance in the task. "Certain" singers ($n = 14$) matched all five pitches correctly. "Uncertain" singers missed one ($n = 6$) or more ($n = 14$) pitches. Students were also asked to complete a perception task where they tuned a synthesizer to a prerecorded reference pitch by turning a knob. Because the six students who missed only one pitch were not easily classified as "certain" or "uncertain," they were eliminated from the results. There was a significant ($p < .05$) difference in the ability of the "certain" singers to match pitch in the perception task versus the "uncertain" singers. This may suggest that students who are better able to identify pitch-matching problems are more likely to perform in-tune. This stands in contrast to Powell's 2010 research synthesis.

However, research has indicated that when students can hear in their mind what pitches sound like before they perform the notes (audiation), that they have better intonation (Smith, 1995; Elliot, 1974). Smith (1995) divided 96 sixth-grade beginning string students into one of four groups: three groups that used an aural skills computer program that provided feedback when students sang and played an instrument, just sang, or just played an instrument, and a control group did not use the program. Smith found that using the program to receive immediate visual and aural feedback improves both pitch discrimination and performance pitch accuracy, regardless of practicing aural skills by singing or playing.

A related study showed that students who have singing instruction along with instrumental instruction scored significantly higher ($p < .05$) on pitch discrimination, mental conversion of sounds to notation, and conversion of notation into sound (Elliot, 1974). Singing instruction allows students to internalize the pitches to be played. Elliot's study also showed that brass students generally scored higher in aural skills than the wind players. This may be due to the differences in pitch production, given that pitches are changed primarily by air rather than keys like wind instruments.

In his article "Singing in the Band Rehearsal," Wolbers (2002) states that singing in the band rehearsal causes students to "think" the sound they are wanting to produce before they play it, which creates a more aware experience for the student. Students who have trouble matching pitch or identifying intonation can develop these skills through singing their parts in the band rehearsal, and they will be able to transfer those skills to their instrumental performances. Students who are more aware of melodic and harmonic

intervals through singing may be more likely to hear and correct intervals while playing their instruments.

Wolbers' views on singing are shared by Robinson (2006) in his article "To Sing or Not To Sing in Instrumental Class." Robinson states that students who are exposed to vocalization in the instrumental classroom are better able to fix their own pitch problems. He believes that singing helps to develop a consistent sense of tonality. He points out that many directors focus on tuning a single pitch at the beginning of rehearsal and assume that intonation will be correct throughout the rehearsal. However, this is an incorrect assumption. Students that are aware of the harmonic context of their own pitches have better intonation because they can hear how their note fits into the overall scheme.

Similar to Wolbers and Whitener, Speck also advocates using solfegé in the instrumental classroom to strengthen instrumental ensemble tuning (2005). Speck states that using moveable "do" solfegé is preferable to using numbers because the students will be less likely to confuse the solfegé with rhythm counting methods. He also states that solfegé is better than singing on a neutral syllable because it provides a basis for developing an aural image of melodic and harmonic relationships. Because children use their voices as their first musical medium, singing in musical ensembles can take place with any age or ability level of student. After the students have learned to listen for melodic and harmonic relationships in music, unstable intonation can be managed by alternating singing and playing. When this is applied to the ensemble as a whole, the ensemble will gain a better grasp of the passage and will develop better aural targets.

Relation to National Standards

The National Association for Music Education offers a set of nine standards that every music classroom nation-wide for all music education settings including general music and performance groups (National Association for Music Education, 2012). The first standard states that children should sing, both solo and in groups, a varied repertoire of music. The second states that children should play instruments, both solo and in groups, a varied repertoire of music. Other standards include evaluating performances, creative thinking in music, and relating music to other subjects. The first two standards—singing and instrumental play—create the foundation of a solid music education, e.g., making music. Standard number six—*listening to, analyzing and describing music*, and seven—*evaluating music and music performances* are also related to the goals of this project. This study seeks to see if combining the two activities of singing and playing instruments positively affects beginning musicians as they listen to, analyze and evaluate the music they are making.

This study was undertaken to continue to study the intonation tendencies of beginning musicians. The purpose of this study was to determine if aural skills as demonstrated through vocal performance have an effect on intonation. Specific questions include:

(1) Does singing before tuning have an effect on intonation?

(2) Does an incorrectly sung pitch have a negative effect on intonation?

(3) Is there a relationship between how long a student has studied music and their ability to sing in-tune?

CHAPTER THREE

METHOD AND MATERIALS

Description of the Study

This study was designed to determine if singing has an effect on the intonation of middle school flute students. This study followed a quantitative path. The project focused on how students tuned their flute with and without singing prior to tuning.

Flute was chosen as the instrument for this research study because it is traditionally tuned by moving the headjoint, making it easy to reset for each student, and because flute is the researcher's primary instrument. The tuning note, Bb, was chosen to tune because it is a common note for band programs to tune in the classroom setting. For the flute players, the Bb above middle C (Bb_4) was chosen as a tuning note because it takes place in the first octave the students would learn. It does not require the added air support that Bb_5 would require to maintain. The researcher provided a flute for all students to use to decrease the potential for individuals' flutes to affect the results of the study due to quality or maintenance issues. The provided flute was sanitized with sanitizing spray in-between every study participant.

Participants

Participants ($N = 33$) were middle school flute players, grades six through eight, enrolled in public schools. These individuals had between one and four years of experience playing their instrument. Schools used for this study were sampled from a major school district in the Southeast. Students for the study needed to meet specific criteria, including being enrolled in their school band program and having flute as their primary instrument. Students were invited to participate through a class announcement by their band director and personal invitation by the researcher.

Procedure

As a control, all students used the same instrument: an Armstrong Model 102 flute. This flute was supplied by the researcher and was sterilized with Sterisol Germicide spray before each performance. Participants were given this flute with the headjoint pushed all the way into the body. The treatments were conducted by the researcher within a two-week period.

There were two phases of this project. First, each participant was asked to tune the instrument to a Bb pitch after hearing a reference Bb major chord and Bb note as played on an electric piano. Participants were given up to 15 seconds to adjust the headjoint or embouchure to match the pitch. Intonation was assessed using the strobe-tuner computer application, *Strobe Tuner*. The flute headjoint was then returned to its original position after each performance.

For comparison, participants then listened to the same piano chord and pitch but were asked to sing the note Bb on the neutral syllable "la" before adjusting their flute and

playing Bb a second time. As with the first performance, individuals were given time to adjust their instrument and embouchure after which intonation was measured by computer. In fifty percent of the trials run, the procedures were altered to compensate for the order effect. Means scores (i.e., accuracy of pitch in cents) between the two treatments were computed and results were compared using a *t*-test based on the two performances.

Pilot

A pilot study was run in the Fall of 2010. The pilot study differed slightly from this study. In the pilot, participants were undergraduate music majors (woodwind and brass) from a major Southeastern university. As in the current study, each participant served as both the control and experimental groups.

The participants were first asked to tune their instruments to a concert F pitch in a comfortable range for their instrument. They were provided with an electronic tuner to do so. After the baseline tuning, the participants were then asked to sight-read a short twelve-tone exercise written by the investigator to clear the musical memory of the pitch center from tuning. After sight-reading, the participants were then asked to tune their instrument to a reference pitch of a concert pitched Bb major chord followed by the Bb note. Next, participants were asked to sight-read another twelve-tone exercise designed to clear musical memory. In the final step, each participant was again asked to tune their instrument to Bb after hearing the same reference pitches. Before they tuned, they were asked to sing the Bb on the neutral syllable 'la.' Measurement of intonation was taken of

each tuning and of the singing. The order of singing/tuning and listening/tuning was reversed in fifty percent of trials to compensate for the order effect.

The pilot study found no significant difference between the intonation when the participants sang the pitch versus when they only heard the reference pitches. The study did find that a significant number of participants were unable to sing in tune ($p < .05$). The results and discussion from the pilot study, as well as the data collection form, the twelve-tone memory clearing exercises, and the raw study data can be found in Appendix A.

Because of the pilot results, two changes were made to streamline the study process. A smaller population was chosen to decrease the amount of variation in tuning between different instruments. A single instrument, flute, was used in the current study. Also, the music distraction exercise was omitted from the current study, as the flute headjoint position is being reset in between each tuning.

Limitations

The following limitations of the current study are listed below.

1. Students did not use their own flutes. This might have cause a variation in student intonation that would not be clearly controlled for.
2. Students were only allowed to participate with guardian-signed consent forms, which limited the sample size.
3. The study was run in teacher offices or hallways, depending on the location available in the chosen school. Outside noise or distractions may have caused a variation in student concentration and intonation.

4. As the sample size was limited to only middle-school flute players, the results may not be applicable to other instruments or age levels.
5. As the study was not run in one central location, factors such as temperature and humidity were not controlled.
6. The flutes were reset to the same position after each tuning. However, there was no music distraction exercise between each tuning, which may have resulted in better tuning in the second trial, regardless of the method.

IRB Approval

The protocol for this study was submitted to the IRB for both the University of Louisville and the Jefferson County Public Schools. It was approved with the use of guardian consent forms and student assent forms. Copies of the consent and assent forms may be found in Appendix B.

CHAPTER FOUR

RESULTS

Students involved in this study were taken from five middle school band programs. These schools were all located in a large metropolitan city in the Southeast. The following outlines the make up of the sample used in this study as well as results from the treatment.

Of the 33 participants, 16 were in sixth grade, 9 were in seventh grade, and 8 were in eighth grade. Students in this study were primarily girls ($n = 31$) 94%. Boys ($n = 2$) only represented 6% of the entire sample. Table 1 summarizes these demographics.

Table 1

Demographics by Gender

Gender	*n*	%
Female	31	94
Male	2	6

These students were assessed in terms of their ability to play the pitch Bb in tune with and without singing a starting pitch. Table 2 summarizes the number of in-tune responses per grade level as measured when (1) the students sang their tuning note, (2)

tuned after listening and singing the note, and (3) tuned after only listening. Appendix C contains a table showing the individual intonation results by grade level.

Table 2

In-Tune Responses by Class and Category

Group	*n*	Sang	Tuned After Singing	Tuned After Listening
6th grade	16	1	3	4
7th grade	9	2	3	2
8th grade	8	3	1	0

Students in this school district start band in grades four, five, and six. Because of this, students in the same grade do not necessarily have the same amount of experience in band. Table 3, below, shows the number of in-tune responses per years of experience as measured when the students (1) sang their tuning note, (2) tuned after listening and singing the note, and (3) tuned after only listening. There were 11 students with one year of experience, 12 students with two years, 4 students with three years, and 4 students with four years.

Table 3

In-Tune Responses by Years of Experience and Category

Years of Experience	*n*	Sang	Tuned After Singing	Tuned After Listening
1	11	0	0	0
2	12	1	3	4
3	4	2	3	2
4	4	3	1	0

Comparisons were made between students' intonation when performances were compared with and without singing the starting pitch Bb. A *t*-test was used to analyze the intonation in cents that participants played, first after singing the pitch and then after hearing the pitch. The results were not significant. A second *t*-test was used to analyze the intonation results between the first tuning and the second tuning regardless of stimuli. This was done since the order of treatment and control were reversed in half the trials to compensate for the order effect. The results from that analysis were also not significant. A chi-square was used to see if there was a significant difference in the amount of participants who sang in-tune and those who did not. There was a significant difference ($df=1, \chi_2 = 16.04, p < .05$): 5 participants sang in-tune and 28 participants did not. A performance was considered in-tune if it was +/- 5 cents from the pitch center.

Consistent with research literature, there were significantly ($df=1, \chi_2 = 24.24, p < .05$) more sharply tuned responses in instrumental intonation than flat responses in chi-square results for responses for intonation after singing and listening to a pitch. There were 53 sharp responses and 13 flat responses in both trials. A *t*-test was run to see

if there was a significant difference in the accuracy of tuning per years of experience. The results were not significant.

CHAPTER FIVE

DISCUSSION

Research literature mentioned previously studied the effect of long-term vocalization and aural skill training on intonation. This study assumes some sort of aural skill training is taking place, as it is important to the success of a band program. This study found that singing directly before tuning a pitch had no significant effect on the intonation of the pitch, but it also found that a significant number ($p < .05$) of participants were not able to sing the pitch in-tune. Out of the six in-tune singing responses, only three of the subsequent intonation responses were in-tune (50%). These results were not significant. It is possible that singing does affect intonation, but additional study would be needed to see if intonation improves when participants do sing in-tune. Although no significant results were found, 15 participants had better intonation after singing than just listening, regardless of their ability to sing in-tune.

It is interesting to note that 20 of the 33 participants sang the correct pitch, although it may have been out of tune. Of these 20 participants, 11 had increased intonation accuracy when they sang the pitch versus when they just heard the pitch and three had the same intonation regardless of stimuli. Only four of the 13 participants who sang an incorrect pitch had increased intonation after singing, although one participant had the same intonation regardless of stimuli. Although it is not significant, these results may indicate that singing assists the student in internalizing the pitch, which may lead to better intonation accuracy.

As previously stated, the stimulus order was changed in 50% of the trials run to compensate for the order effect. A *t*-test was run using data from the first and second trials to see if tuning more often increased intonation accuracy. This *t*-test was not significant. The mean intonation from the results of intonation after singing was +10.33 cents (S.D. = 15.65); the mean intonation without singing (just listening) was +12.82 cents (S.D. = 17.70). The mean results from the first tuning regardless of stimuli were +9.61 (S.D. = 16.09); the second tuning was +12.64 (S.D. = 16.69). These results do not have significant differences.

Data from singing intonation and a student's grade level suggests that sixth graders were the least able to sing in-tune (6%). However, because the participation from each grade level was varied, I do not feel that an accurate conclusion can be drawn. As seen previously in Table 1, one of the 16 sixth graders sang in-tune (6%), two of the 9 seventh graders (22%) and three of the 8 eighth graders (37%). It is expected that students who have performed music longer will have better singing intonation, and this study shows that eighth grade students are more likely to sing in-tune.

Data from singing intonation and a student's experience level in school indicates that first year students were the least able to sing in-tune (0%). As before, because the participation from each experience level was varied, I do not feel that an accurate conclusion can be drawn. As seen previously in Table 2, none of the 11 first year students sang in-tune (0%), one of the 12 second year students (8%), two of the 4 third year students (50%), and three of the 4 fourth year students (75%). This study substantiates the hypothesis that students with more performing experience are more likely to sing in-tune, but a larger study, or a study with more equal participation

throughout grade and experience levels, would be needed before comparing singing intonation and grade level.

Several interesting observations were noted while the study was being conducted. Students often moved their headjoints to a pre-determined location (presumably where they usually set their own flutes when they play) before ever playing or hearing a tuning note. The students were told in the study introduction that they could "adjust the headjoint by pulling or pushing it into the body of the flute, changing the angle of the headjoint, or changing air flow." Only a few students altered this position after playing the first tuning note; the rest tried to alter the pitch with air flow instead of physically adjusting the instrument. When the headjoint was reset for the second trial, the students were told that they could move the headjoint again if they would like, and, like the first trial, most students moved it back before playing the second note.

Sixth grade students had the most problems with the instructions. Several of the 6^{th} graders, when asked to "tune the flute and tell me when you feel the pitch is the same that you just heard," would indicate they understood, but after tuning would look confused and ask if they were correct. They were told "I want to know when **you** think it is correct. Just tell me when it sounds like the note I played for you." They would then play the note again, and indicate that it was in tune. It is not certain if this meant the students did not understand what was being asked of them or if they just were not sure how to tune a flute. One or two students asked what was meant by "tune the flute", and they were advised to "play the flute until the pitch you are playing sounds like the one you just heard."

Only two students re-sang the pitch while tuning on the singing trial. Both were actually singing wrong notes, but their intonation was better in the singing trial than when they didn't sing. Although it was expected that students would be shy about singing in front of the researcher, this was not as big of an issue as anticipated. When giving the directions, the researcher demonstrated how the pitch was to be sung. I believe that hearing the researcher give the example enabled the students to be less hesitant about singing. There were a few students who wanted to hum the pitch instead of singing it, but they complied when the researcher told them that the computer needed to be able to pick up their sound.

There are several limitations to the findings of the study. Because guardian consent forms were required for participation, only 33 students were able to participate. Teachers in each of the schools indicated that this was likely not because guardians did not want their students to participate but because students can be forgetful about paperwork. A larger sample of middle school students might yield different results. As a result of the consent forms, not all flutists in each school participated. It is possible that stronger or weaker students could have skewed the results of this study.

All students participating came from the same locale. It is possible that investigating students from different parts of the country may result in different findings. Also in regards to location, the study was not run in a controlled environment. The researcher visited each of the schools to work with participants, and the study was run in teacher offices, hallways, and unused classrooms. Because of this, outside noises and other interruptions may have been distractors that altered results.

Although the flutes were reset to the original headjoint position after each trial, the students may have still retained a musical memory of the previous tuning pitch. It is possible that this made the second tuning more likely to be correct (although it was not significantly so, as indicated in Chapter Four). Use of a distractor to block tonal memory may have resulted more accurate results.

As previously mentioned, some students were confused by the directions "tune the flute." Those that did understand the directions sometimes tuned the flute before they heard a reference pitch. Because of this, the students may not have actually tuned their flutes but instead assumed the pitch played would be correct. This would have skewed test results.

Perhaps the most obvious limitation to the study is that only middle school flute players were used. Results with different age groups or instruments may produce different results. Additional research with broader and larger populations are needed before these results could be applicable to other populations. Continuing research on singing and intonation is valuable to other music educators because intonation is a problem that all musicians battle when performing. It is possible that better ear-training methods in beginning bands may assist students in becoming better musicians.

Although this study is not directly applicable to other populations, there is one aspect of the study that has appeared twice: the ability of students to sing in tune. In both the 2010 Pilot Study and the current study, a significant ($p < .05$) number of students were unable to sing in tune. In the current study, it was more pronounced as these students have had far less ear-training study than the undergraduate music majors used in the pilot. If students cannot produce an in-tune pitch with their voices, it does not seem

practical to expect them to be able to hear in-tune pitches with an instrument. It could be that music educators need to focus on the students' abilities to hear and produce in-tune pitches by singing and that better intonation on musical instruments may follow.

Further research in the area of vocalization and intonation is needed before a conclusion can be drawn in regards to the findings presented here. Although many ensembles sing before tuning, this study's results show that singing is not guaranteed to produce a more in-tune performance. Additional study and larger population samples may yield more conclusive results. It may be more useful to study vocalization and intonation in regards to singing tonal sequences or patterns rather than by an individual note. Future studies may also research what type of models students receive in regards to singing and tuning.

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APPENDIX A

Pilot Study: The Effect of Singing on the Intonation of Undergraduate Music Majors

Method

Participants

Participants included 30 undergraduate music major students enrolled in applied lesson studios at a large southeastern university. The students were woodwind or brass instrumentalists and had been studying their primary instrument between 4 and 14 years. Students were invited to participate through class announcements, signs throughout the building, and personal invitation as they were practicing.

Procedure

Participants were directed to use a Korg Chromatic CA-1 tuner on their stand to tune to an F (A=440) in a comfortable range for them to establish a baseline of tuning. They were then directed to sight-read Line 1 of a twelve-tone exercise written by the investigator designed to clear the ear of the tuning pitch (See Figure 1 on page 42 for the music utilized). After playing the exercise, which was not measured, the participant was directed to listen to a pre-recorded concert pitch Bb major chord (A=440) performed by a Yamaha Clavinova CLP-411 using the "piano" setting, followed by a Bb concert pitch sustained for four seconds. The stimulus was played back through computer speakers with a MacBook Pro using iTunes 10.1. The participant was then asked to tune to the Bb, and after 4 seconds, the intonation of the note was measured using an online chromatic tuner previously tested to be in-tune with the recorded stimulus.

Afterwards, the participant was directed to "think of the 8th note pulse that runs through Line 2" and to tap it on a Dr. Beat DB-66 to establish a tempo. The participant was directed to sight-read Line 2 with the metronome. After playing, which was not measured, the participant was again directed to listen to a pre-recorded Bb major chord on the piano followed by a Bb pitch sustained for four seconds. The participant was asked to sing the Bb pitch on a 'la' syllable for four seconds and then to tune it on their instrument. This pitch was measured after four seconds using a tuner. To account for order effect, half the participants sang on their first tuning and half the participants sang on their second tuning. Data gathered from the participant included the number of years they had studied their instrument and their year in college (see Figure 2 for the form used for data collection).

Results

A *t*-test was utilized to analyze the intonation in cents that participants played after singing the pitch and after just hearing the pitch. The results were not significant. A second *t*-test was used to analyze the intonation results from the first tuning and the second tuning since the order of singing and listening to tune was reversed in half the trials to compensate for the order effect. The results from that analysis were also not significant. A chi-square was run to see if there was a significant difference in the amount of participants who sang in-tune and those who did not. There was a significant difference ($p < .05$): 7 participants sang in-tune and 23 participants did not. A performance was considered in-tune if it was +/- 5 cents from the pitch center.

Of the 30 participants, 12 were Freshmen, 4 were Sophomores, 10 were Juniors, and 4 were Seniors. Table 4 shows the number of in-tune responses per grade level as measured when the students sang their tuning note, tuned after listening and singing the note, and tuned after only listening.

Table 4

In-Tune Responses by Class and Category

Group	Sang	Tuned After Singing	Tuned After Listening
Freshmen	1	3	4
Sophomores	2	3	1
Juniors	3	5	5
Seniors	1	0	1

Table 5 shows the individual intonation results by grade level and instrument type. Consistent with research literature, there were a significant number more of sharply tuned responses in instrumental intonation than flat responses ($p < .05$) in chi-square results for responses for intonation after singing and listening to a pitch. There were 22 sharp responses and 7 flat responses in both trials (one response from each trial was excluded because it was 0 cents sharp/flat).

Discussion

Research literature mentioned previously studied the effect of long-term vocalization and aural skill training on intonation. This study assumes aural skill training is taking place, as it is part of the required curriculum for music majors at this university. This study found that singing directly before tuning a pitch had no significant effect on the intonation of the pitch, but it also found that a significant number ($p < .05$) of participants were not able to sing the pitch in-tune. Out of the seven in-tune singing responses, only three of the subsequent intonation responses were in-tune. These results are not significant. It is possible that singing does affect intonation, but additional study would be needed to see if intonation improves when participants do sing in-tune. Although no significant results were found, 12 participants had better intonation after singing than just listening, regardless of their ability to sing in-tune.

As previously stated, the stimulus order was changed in 50% of the trials run to compensate for the order effect. A *t*-test was run using data from the first and second readings to see if tuning more often increased intonation accuracy. This *t*-test was not significant. The mean intonation from the results of intonation after singing was +4.83 cents; the mean intonation without singing (just listening) was +4.67. The mean results from the first tuning regardless of stimuli were +4.97; the second tuning was +4.53. These results do not have significant differences.

Data from singing intonation and a student's grade level in college indicates that first year college students (freshmen) were the least able to sing in-tune (8%). However, because the participation from each grade level was varied, I do not feel that an accurate conclusion can be drawn. As seen previously in Table 3, two of the four sophomores

sang in-tune (50%), three of the ten juniors (30%) and one of the four seniors (25%). While it may be expected that students who have studied longer at a secondary level will have better singing intonation, this study shows that second year students are more likely to sing in-tune. A larger study, or a study with more equal participation throughout grade levels, would be needed before comparing singing intonation and grade level.

Further research in the area of vocalization and intonation is needed before a conclusion can be drawn in regards to the findings presented here. Although many ensembles sing before tuning, this study's results show that singing is not guaranteed to produce a more in-tune performance. Additional study and larger population samples may yield more conclusive results.

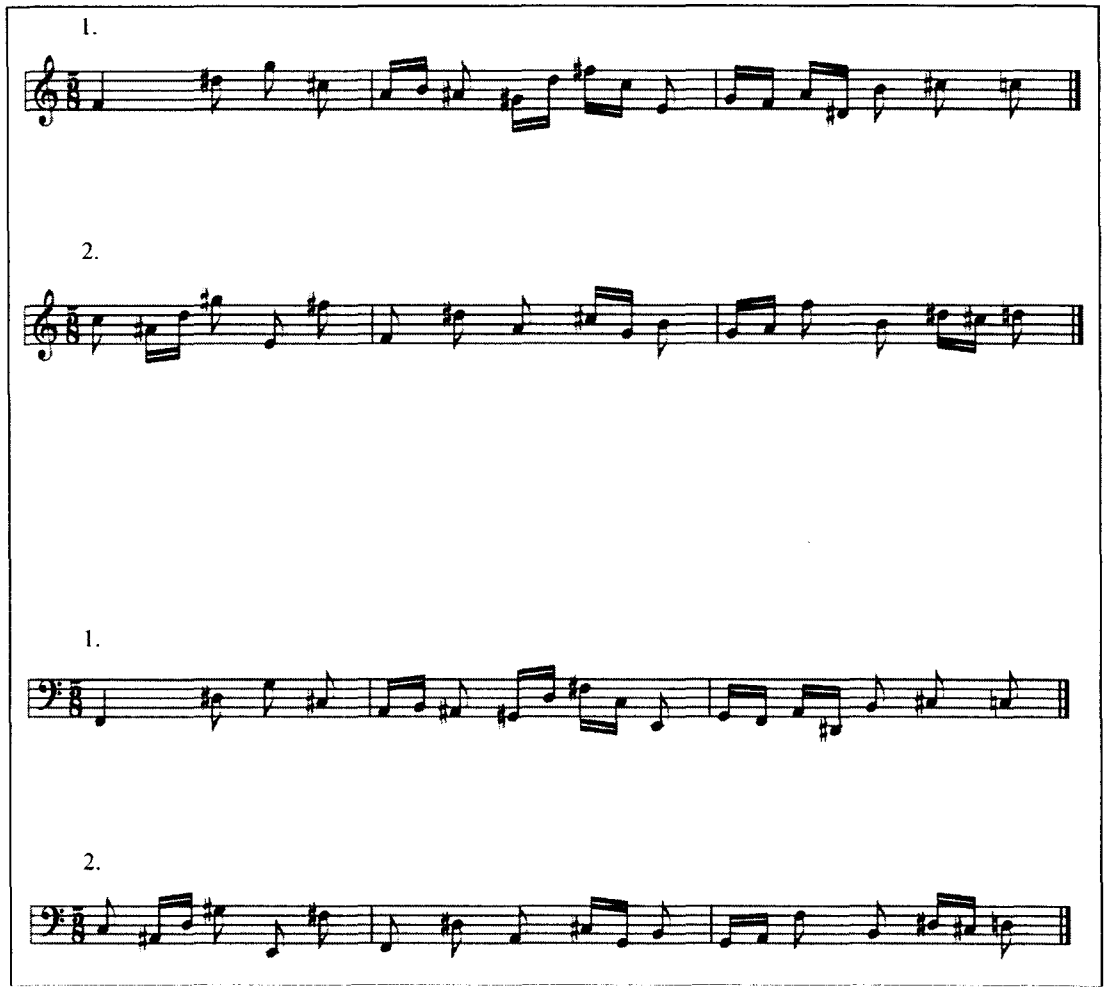

Figure 1: Music Distractor Exercises in 12-Tone Composed by Investigator

Fl Cl Ob Bsn Sax FH Tpt Tbone Euph Tuba

Years studying instrument:_____ Freshman / Sophomore / Junior / Senior

Please use the tuner on your stand to tune to an F in a comfortable range for you. Please let me know when you are done.

There is a sheet of music on your stand, please turn it over, and sight-read line #1. You may begin when you are ready.

**Thank you. You will now hear a tuning chord and pitch. Please tune your instrument to a Bb concert pitch and hold that pitch for 4 slow beats.

Intonation of pitch:_____

Please look again at the music on your stand. Using the metronome on the table, please tap the tempo at which you would prefer to play line #2.

I will turn on the metronome. Please play line #2 in tempo with the metronome.

**Thank you. You will now hear a tuning chord and pitch. When you hear the Bb concert pitch, please sing that pitch on a "La" syllable for 4 slow beats. Afterwards, please tune it on your instrument, and play the pitch for four slow beats.

Singing intonation:_____

Intonation of pitch:_____

Thank you for your assistance in this study.

**These 2 sections were reversed on 50% of the trials run in order to compensate for the order effect.

Figure 2: Data Collection Form

Table 5

Individual Intonation Results: Raw Study Data (Pilot Study)

Instrument	Grade Level	Singing Pitch	Pitch After Singing	Pitch without singing	Order: 1st
Woodwind	1	-7	13	1	sing
Woodwind	2	-2	5	19	sing
Woodwind	4	8	23	20	listen
Woodwind	1	13	10	9	sing
Woodwind	3	8	5	3	sing
Woodwind	1	23	-10	-7	listen
Woodwind	1	-36	4	8	sing
Woodwind	2	-4	-4	-1	listen
Woodwind	3	19	2	3	sing
Woodwind	1	29	11	6	sing
Brass	2	6	0	8	listen
Brass	2	D 8	7	14	sing
Brass	3	D -5	12	-1	listen
Brass	4	-4	-8	-6	sing
Brass	1	F -17	8	9	listen
Brass	1	-37	17	12	sing
Brass	1	6	5	13	listen
Brass	1	15	18	1	listen
Brass	3	-1	10	13	sing
Brass	1	-7	-1	0	sing
Brass	3	24	30	25	sing
Brass	3	-4	1	-24	listen
Brass	3	15	3	1	listen
Brass	3	33	4	13	listen
Brass	4	-6	6	9	listen
Brass	3	-1	-6	5	listen
Brass	1	-3	6	-12	sing
Brass	1	-18	-6	1	sing
Brass	4	-10	10	5	listen
Brass	3	18	-30	-7	listen

Appendix B

Subject Assent and Consent Forms

SUBJECT ASSENT

IRB# and The Effect of Singing on the Intonation of Middle School Flute Students

I am invited to be in a research study being done by Dr. Robert Amchin and Ms. Ashley Mattingly. When a person is in a research study, they are called a "subject". I am invited because I am a middle school flute player between the ages of 11 and 16.

This means that I will tune several notes with a flute and sing one pitch. There are minimal risks to participate in this study. These risks are that, since I will be using a sanitized flute used by others, I could get ill from playing the same flute played by other students. However, I know that the researcher is cleaning the flute headjoint with sanitzer solution before I play this flute.

This study will last approximately 10 minutes. The benefit to me for participating in this study is that I may learn how to better tune my flute.

My family, the professors, and my band director will know that I'm in the study. If anyone else is given information about me, they will not know my name. A number or initials will be used instead of my name.

I have been told about this study and know why it is being done and what I have to do. My parent(s) have agreed to let me be in the study. If I have any questions I can ask Ms. Mattingly. She will answer my questions. If I do not want to be in this study or I want to quit after I am already in this study, I can tell the researcher and she will discuss this with my parents.

Printed Name of Subject	Signature of Subject	Date Signed

Printed Name of Parent/Guardian

Printed Name of Investigator	Signature of Investigator	Date Signed

UNIVERSITY OF LOUISVILLE
INSTITUTIONAL REVIEW BOARD
Date Approved 02/20/2012 Valid Thru 02/19/2013

Assent version 1/27/12

Subject Informed Consent Document

Singing and Flute Intonation

IRB assigned number:
Investigator(s) name & address: Dr. Robert Amchin, 2301 S. Third St., Louisville, KY 40292
Site(s) where study is to be conducted: Olmsted Academy South, Noe Middle School, Crosby Middle School, Brown School, Thomas Jefferson Middle School, Meyzeek Middle School, Johnson Traditional Middle School, Farnsley Middle School, Olmsted Academy North
Phone number for subjects to call for questions: Ashley Mattingly, (270) 316-0154

Introduction and Background Information

You are invited to participate in a research study. The study is being conducted by Dr. Robert Amchin and Ashley Mattingly. The study is sponsored by the University of Louisville, Department of Music. The study will take place at Crosby Middle School, Noe Middle School, Olmsted Academy South, Brown School, Thomas Jefferson Middle School, Meyzeek Middle School, Johnson Traditional Middle School, Farnsley Middle School, and Olmsted Academy North. Approximately 60 subjects will be invited to participate.

Purpose

The purpose of this study is to see if singing before tuning increases the accuracy of flute intonation.

Procedures

In this study, you will be asked to tune two notes on a flute and to sing one pitch.

Potential Risks

There are risks associated with playing the researcher's flute. The risk is that the subject may get ill from playing the same flute as the other subjects. To limit the chance of this risk, the flute will be sanitized between each subject's performance. There may be unforeseen risks.

Benefits

The possible benefits of this study include learning to better tune a flute. The information collected may not benefit you directly. The information learned in this study may be helpful to others.

Compensation

You will not be compensated for your time, inconvenience, or expenses for your participation in this study.

Confidentiality

Total privacy cannot be guaranteed. Your privacy will be protected to the extent permitted by law. If the results from this study are published, your name will not be made public. While unlikely, the following may look at the study records:

The University of Louisville Institutional Review Board and Human Subjects Protection Program Office.

All data collected from this study will be stored in the researcher's locked office and tabulated on a password-protected computer.

Voluntary Participation

Taking part in this study is voluntary. You may choose not to take part at all. If you decide to be in this study you may stop taking part at any time. If you decide not to be in this study or if you stop taking part at any time, you will not lose any benefits for which you may qualify.

U.S. Department of Education (DOE) Funded Studies

Because this study is funded by the U.S. DOE or this school system receives funding from the DOE, we are required to tell you the following information.

The information we collect from the education or study records of you or your child may only be used to meet the purposes of the study as stated in this consent. We will conduct this study in a manner that does not allow identification of you or your child by anyone other than study team members or others who may have a legitimate reason to know. All instructional materials or survey instruments used for the research, including teachers' manuals, films, tapes, or other supplementary instructional material used in connection with this study, are available for you to see before the study begins if you ask to see it. If you want to see any of this information, please contact **Ashley Mattingly, (270) 316-0154** and they will give you a date and time where it will be available for you to review. Once we have completed this study, we are required by the U.S. Department of Education to destroy or return to the school system all personally identifiable information when no longer needed for the purposes of the study. We expect this study to last for 1 day and we will destroy or return the information to the school system on the same day the study is completed.

Research Subject's Rights, Questions, Concerns, and Complaints

If you have any concerns or complaints about the study or the study staff, you have three options.

You may contact the principal investigator at (502) 852-0536.

If you have any questions about your rights as a study subject, questions, concerns or complaints, you may call the Human Subjects Protection Program Office (HSPPO) (502) 852-5188. You may discuss any questions about your rights as a subject, in secret, with a member of the Institutional Review Board (IRB) or the HSPPO staff. The IRB is an

independent committee composed of members of the University community, staff of the institutions, as well as lay members of the community not connected with these institutions. The IRB has reviewed this study.

If you want to speak to a person outside the University, you may call 1-877-852-1167. You will be given the chance to talk about any questions, concerns or complaints in secret. This is a 24 hour hot line answered by people who do not work at the University of Louisville.

This paper tells you what will happen during the study if you choose to take part. Your signature means that this study has been discussed with you, that your questions have been answered, and that you will take part in the study. This informed consent document is not a contract. You are not giving up any legal rights by signing this informed consent document. You will be given a signed copy of this paper to keep for your records.

Signature of Subject/Legal Representative	Date Signed
Signature of Person Explaining the Consent Form (if other than the Investigator)	Date Signed
Signature of Investigator	Date Signed

LIST OF INVESTIGATORS	PHONE NUMBERS
Dr. Robert Amchin, supervisor	(502) 852-0536
Ashley Mattingly	(270) 316-0154

UNIVERSITY OF LOUISVILLE
INSTITUTIONAL REVIEW BOARD
Date Approved 02/20/2012 Valid Thru 02/19/2013

APPENDIX C

Table 6

Individual Intonation Results: Raw Study Data

Student	Age	Year in School	Years Playing	Pitch without singing	Pitch with singing	Singing Pitch	Order: 1st
HT	15	8	3	+35	+30	+35	listen
NA	15	8	1	+25	+19	E +7	sing
AM	14	8	4	+20	-3	-1	listen
MK	14	8	4	+17	+30	+9	listen
CO	13	8	4	+10	+20	A +15	sing
ZL	13	8	4	+30	-7	+5	sing
KM	13	8	4	+20	+15	+3	listen
OD	13	8	3	+6	+10	G# +12	sing
NS	13	7	2	+1	+2	-3	listen
AS	13	7	2	+23	+1	-11	sing
TG	13	7	2	+15	+5	+21	sing
AF	13	7	2	+34	+13	+5	listen
DM	13	7	1	-18	-13	+8	listen
SA	13	7	1	-40	-30	+9	sing
EH	12	7	3	+4	+15	B -13	sing
LT	12	7	3	+25	+30	G# -27	listen
TL	12	7	2	-16	+30	+36	listen
HH	12	6	2	+3	+5	-26	listen
HG	12	6	2	+14	+33	+8	sing
LF	12	6	2	+20	+20	+20	listen
BM	12	6	1	+36	+17	B -8	sing
HA	12	6	1	+10	+10	D +38	sing
TT	12	6	1	+10	+10	+14	listen
BJ	12	6	1	+13	+17	+12	listen
SL	11	6	2	+5	+5	+5	listen
MB	11	6	2	+20	+25	C# +10	sing
CZ	11	6	2	-3	+15	C# +20	sing
CV	11	6	2	+3	-3	D -13	listen
ZA	11	6	1	-17	-13	+7	listen
DD	11	6	1	+26	+20	+23	sing
JS	11	6	1	+30	+34	Eb -7	listen
JN	11	6	1	+20	-12	D +23	sing
MB	11	6	1	+42	-9	C# +46	sing

CURRICULUM VITAE

Name:	Ashley Marie Mattingly
Birthplace:	Owensboro, Kentucky
Birth year:	August 25, 1983
Higher Education:	University of Louisville Louisville, Kentucky Master of Music Education (2012) Murray State University Murray, Kentucky Bachelor of Music in Education (2006)
Experience:	University of Louisville Louisville, Kentucky 2010-2012 Graduate Teaching Assistant Owensboro Public Schools & Daviess County Public Schools Owensboro, Kentucky 2008-2009 Substitute Teacher Fulton County Public Schools Hickman, Kentucky 2006-2007 District Band Director P-12 Marshall County High School Benton, Kentucky Calvert City Elementary School Calvert City, Kentucky 2006 Student Teacher