THE INFLUENCE OF SOUND ENVELOPE SHAPE ON INSTRUMENTAL MUSIC EDUCATORS' PREFERENCES FOR CONCERT BAND CRESCENDOS

by

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ABSTRACT

This study examined musicians' preferences for hearing a concert band crescendo with different rates of intensity change. Music educators (N = 62) rated six recordings of a crescendo performed by a digital concert band for similarity to an "ideal concert band crescendo." Each recording was altered to specifically examine a recommended technique for teaching a full band crescendo to student musicians (Casey, 1991; Jackson, 2010; Jagow, 2007; Lisk, 2006). Different rates of intensity change were applied to an unaltered V^7-I concert band recording to simulate sound envelopes shaped as a wedge, ramp and bell. Findings indicated a significant preference ($p < .05$) for all instruments to increase loudness logarithmically in the shape of a trumpet bell when performing a full band crescendo.

LIST OF ABBREVIATIONS AND SYMBOLS

df	Degrees of freedom: number of values free to vary after certain restrictions have been placed on the data
F	Fisher's *F* ratio: A ratio of two variances
z	z score: measurement of a score's relationship to the mean
N	Number of participants
n	Number of sub-group participants
p	Probability associated with the occurrence under the null hypothesis of a value as extreme as or more extreme than the observed value
<	Less than
=	Equal to
n_p^2	Partial Eta Squared

DEFINITIONS OF TERMS

Envelope	The attack, sustain and decay of a musical tone or sound
Intensity	The loudness of a sound measured in decibels
Dynamics	Musical term for variations in intensity
Volume	The intensity of a sound as a subjective determination
Crescendo	Music term for a gradual increase in the intensity of a sound

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CHAPTER 1

INTRODUCTION

Changing dynamics is a fundamental element of contemporary music that provides a level of interest and emotional significance to most performances. The practice of increasing and decreasing the intensity of sound when performing is emphasized at all levels of a musician's career. Conductors and other music educators knowingly cultivate a wide range of dynamic contrasts when rehearsing their bands and ensembles. When a concert band performs without a change in intensity, especially when the score specifically calls for a dynamic change, the integrity of the performance and the intentions of the composer can be compromised. If eliciting a musical response from performers and audiences is one of the goals of studying music, and changes in intensity contribute to the aesthetics of music, then it seems especially important for music educators to develop student musicians who are able to perform music with varying dynamic levels in ensemble settings. Phrases such as "louder," "softer," and "over exaggerate" are commonly heard statements in a concert band rehearsal suggesting an awareness of the need for dynamic contrasts when making music.

In the pursuit of musical concert band performances, several pedagogues developed teaching strategies for band directors to apply when instructing students (Casey, 1991; Jackson, 2010; Jagow, 2007; Lisk, 2006). Together these approaches influence the practices of instrumental music educators and are frequently advocated by other band directors, seminal texts and college methods classes. However, a body of research literature supporting these widely used methods remains elusive. It seems many of the practices used to teach the acceptable

performance of dynamics in large ensembles draws solely from the opinions and testimonies of accomplished directors and teachers, which vary considerably.

Research examining dynamics revealed several interesting relationships that may be useful for conductors and music educators to consider. For example, several studies support the notion that crescendos are perceived to have a greater change in intensity when compared with decrescendos (e.g., Geringer, 1995; Susini, Meunier, Trapeau, & Chatron 2010). Other studies indicate that regardless of musical training, the onset of a decrescendo is detected earlier than a crescendo (Geringer, 1991). However, it should be noted that in music, it is rare to observe a change in one music element without experiencing a concomitant change in another. For example, changing intensity levels can affect the perception of tempo (Hong, 2003), the perceived duration of a performance (Kellaris & Altsech, 1992), and even the perception of instrument timbre (Haack, 1975).

The relationship of performing contrasting dynamics with complex musical constructs includes investigations examining music preferences, focus of attention and aesthetic responses to music. In music preferences, for example, Gordon (1960) examined several concert band performances during adjudication and documented their decibel ranges using an oscilloscope. Observations showed bands with the widest range of dynamic contrast received the highest performance ratings during adjudication. Burnsed & Sochinski (1995) examined the music preferences of middle school students. In this study, the participants listened to several recordings of folk songs, each having a flat and expressive dynamic performance and documented their preferences. Overall, the students preferred the expressive dynamic performances to the flat dynamic performances. In another study, Burnsed (1998) examined the music preferences of elementary students when listening to folk songs. In general, the students

preferred folk music performed with expressive dynamics to music without expressive dynamics. Interestingly, the preference of dynamics in music increases as individuals gain considerable musical experiences (Burnsed, 2001). Clearly, dynamics add to the appeal of music across populations.

In a series of studies investigating what persons attend to when listening to music, the importance of dynamics to the listening experience clearly stands above most other music elements. For example, Madsen and Geringer (1990) investigated the listening patterns of musicians and non-musicians using the Continuous Response Digital Interface to record whether they were listening to melodic, timbral, dynamic, rhythmic or all aspects of the performance. Participants' time spent on each element was calculated and compared revealing significantly different listening patterns between musicians and non-musicians. Musicians spent the majority of their time focused on melody, rhythm, dynamics and timbre in that order, while non-musicians focused on dynamics, melody, timbre, everything and lastly rhythm.

In a later study, Madsen (1997) tested experienced musicians on their attentiveness to various musical elements and how the areas of attentiveness related to their aesthetic responses to the final twenty minutes of Act I of Puccini's *La Boheme*. Half of the participants indicated which musical element (dynamics, timbre, melody, rhythm or everything) commanded their attention while listening and the other participants were assigned to focusing only on one of the five musical elements. Participants assigned to follow all elements simultaneously had the highest percentage of attention for dynamics, followed by everything, melody, rhythm and timbre. Results suggest melody and dynamics affected aesthetic responses more so than any other element. Based on these studies, it is clear that changes in intensity greatly influence a listener's perception of a musical performance.

The pedagogy of instructing concert bands is replete with techniques and methods designed to help music educators teach ensemble dynamics. However, these methods rely on describing techniques applied to individual musicians, or present inconsistent information (Madsen & Madsen, 1997). For example, Casey (1991) advocates crescendos should remain soft and then dramatically increase in intensity at the end, in essence following a contour similar to the shape of a trumpet bell. This is contrary to the more common practice of the crescendo increasing in sound consistently and evenly across the entire sound envelope, which is typically depicted as the shape of a wedge (Jackson, 2010; Lisk, 2006).

Jagow (2007) suggests that because the concert band exhibits numerous timbres it is appropriate to teach crescendos to occur in sections where the lower voices crescendo first, followed by the middle voices and finally the high voices. By starting the crescendo from the bottom, the overall balance and blend of the ensemble will be maintained and a more appropriate performance will take place. This approach to full band crescendos suggests some band directors perceive a relationship between instrument timbre, range, and the performance of dynamics.

Given the extant research examining the elements of music, varied acceptable instrumentation of the modern concert band (Feldman & Contzius, 2011), and differences in intensity produced by individual instruments (Ballou, 2008; Wagner, 1994), there is surprisingly little research focused on the preferences for different performance practices with full-band crescendos. The varied timbres within the concert band suggest that an investigation of the influence of different approaches to performing a crescendo as an ensemble would be beneficial in understanding how ensemble dynamics should be taught to students and performed during concerts. Moreover, considering the importance of dynamic contrasts to the perceived musicality of a performance, and the conflicting pedagogical recommendations for performing a full-band

crescendo, it seems necessary to determine which method of producing a gradual change in intensity for a concert band is desired by instrumental music educators.

Purpose of Study

The purpose of this study was to examine musicians' preferences for hearing a concert band crescendo under different rates of intensity change. The following research questions were investigated:

Research Questions

1. Does a unison envelope shape performed by all instruments in a concert band affect instrumental music educators' preferences for an ensemble crescendo performed by the wind section of a concert band?
2. Does the practice of using different envelope shapes by instrument section in a concert band affect instrumental music educators' preferences for an ensemble crescendo?
3. Are instrumental music educators' preferences for a specific performance of an ensemble crescendo affected by their experience, career status, or primary instrument?

CHAPTER 2

REVIEW OF LITERATURE

In preparation for conducting this study, the researcher reviewed studies on preferences, perceptions, tempo, tension, aesthetics, approvals, disapprovals, attention and conducting to develop a complete understanding of the factors affecting music preferences based on empirical research. Near the conclusion of this review there are several resources examining pedagogical techniques for teaching dynamics to musicians in concert bands. The researcher reviewed accepted pedagogical practices for performing a full ensemble crescendo and was able to incorporate each practice into the stimuli used for the present the study.

Musical Preferences

Every music listener, performer and educator exhibits preferences as to what music they utilize in their daily lives. Whether it is because the music possesses the right tempo, is full of dynamic contrast or uses certain instrumentation, it is evident that many aspects affect what music an individual enjoys. Researchers have attempted to study what musical attributes effect this phenomenon and which of these attributes, if any, affect it the most. Results indicate that a listener's age (LeBlanc, Sims, Siivola & Obert, 1996), degree of vibrato (LeBlanc & Sherrill, 1986), repeated listening (Bradley, 1971), tempo speed (Geringer, 2010; LeBlanc, Colman, McCrary, Sherrill, & Malin, 1988) and arranged versus authentic renditions of world melodies influence preferences among students (Demorest & Shultz, 2004). Moreover, examination of Gordon's Instrument Timbres Preference Test indicates that electronic timbres may not adequately represent timbres of authentic instrumental sounds (Williams, 1996).

LeBlanc, Sims, Siivola and Obert (1996) compared music style preferences of different age listeners. Participants listened to stimuli representing three different styles of music: art music, jazz and rock. Within each of these styles, each participant listened to six excerpts with different tempos—two slow, two moderate and two fast. This created 18 musical examples total, all of which were heard in random sequence. Participants were asked to rate each listening example immediately after hearing it without making comparisons between the selections. Likert-type scales were used which were altered appropriately for grade level (elementary had no words on the scale but instead pictures). For all excerpts, the preferences were higher for the younger age participants and progressively decreased as the groups increased in age. As the participants reached grades eight and nine, their preferences started increasing and steadily increased with each older grouping.

LeBlanc and Sherrill (1986) measured the effect of low and high levels of vocal vibrato by both male and female performers on the self-reported music listening preferences of upper elementary school children. Both male and female students expressed higher preferences for low levels of vibrato and male singers. The preference for low level vibrato and male singer was lower for female students than male students.

Demorest and Shultz (2004) conducted a combination study which tested fifth graders' preference for authentic and arranged versions of world music recordings, the relationship of those preference ratings to familiarity and teachers' ability to predict student preferences. For Study one, classes of fifth graders were randomly assigned to an authentic or arranged listening condition and indicated their familiarity and preference for 19 world music songs using a six-point Likert-scale. Teachers attempted to predict the students' results and documented their predictions. For study two, students heard both versions of each song side by side and were

asked to choose the version they liked best, then indicate strength of preference and familiarity. Results of both studies indicated that familiarity with a world music song is positively related to students' preference for that song. Participants in study one showed no significant difference in preference ratings for authentic versus arranged conditions. However, participants in study 2 overwhelmingly preferred arranged versions over authentic. Teachers' predictions were closely related to what the students placed although teachers' predictions tended to be a little higher.

Bradley (1971) tested classes of seventh grade students on the effect of multiple listenings on music preference. This study used 12 excerpts for the listening (three tonal, three polytonal, three atonal and three electronic). A pretest was done where the Participants listened to the musical excerpts and rated their preference for each. Afterwards, the participants participated in 14 weeks of listening during 28 class periods where each excerpt was heard a total of three times. A posttest was given to document the preferences of the students after the 14-week listening period. All four categories of music showed a significant gain in preference when compared to the pretest.

Geringer (2010) tested music majors' preferences for tempo and pitch levels for 10 recorded symphonic excerpts (five relatively fast and five relatively slow). Participants were music majors from Florida State University and were separated into three groups: Tempo only, pitch only and combined tempo and pitch. Participants used dials, which changed the tempo and/or pitch of the excerpts depending on which group they were in. Range of modulation for all groups encompassed +or- 18% relative to the original recording. Listeners preferred increased pitch and tempo for the slower excerpts and decreased tempo for the faster excerpts but little change in pitch (with the combined group it was slightly decreased tempo/pitch adjustment). Deviations from the original recording were greatest with the tempo only group.

LeBlanc, Colman, McCrary, Sherrill, and Malin (1988) investigated the tempo preferences of different age music listeners. Students in 45 classrooms were tested from third grade through college on the effect of four levels of tempo on self-reported preferences for traditional Jazz music listening. The students were categorized into six different age groups. The results indicated a U shaped curve where younger students had higher preference than middle school age and then gradually increased as the students got older. All ages preferred faster tempos than slower tempos.

Williams (1996) examined the validity of Gordon's Instrument Timbre Preference Test (ITPT). This test utilizes synthesized sound files as representations of acoustic band instruments. Participants were asked to respond to questions of preference and recognition of the actual test items. Results indicated that a number of the test timbres failed to represent actual instrumental timbres. Students recognized the timbre of the instrument they actually played 52% of the time and preferred the Gordon's timbre of that same instrument 57% of the time.

Musical Perceptions

Perception is a large area of interest for researchers in numerous fields of study. In music, perceptions of what is happening within the music can dictate how it is performed, taught, learned and whether or not it is enjoyed. How one perceives an element of music can help the field better understand how to get more musical styles out to the general public and help to better educate people about musical concepts. Results indicate that volume, intensity (Stevens, 1934), and experience (Taylor, 1976) effects perception of tone. Moreover, results indicate that perception of tempo is affected by speed of repetitive tones (Duke, 1989; Duke, Geringer, & Madsen, 1991; Geringer & Madsen, 1992) legato and staccato articulation (Geringer, Madsen, MacLeod & Droe, 2006), and experience (Sheldon, 1994). In addition, age (Fredrickson, 1997),

musical training (Fredrickson, 1999), and experience (Fredrickson, 2003) seem to have no significant effect on the perception of tension. Research indicates that tension is perceived differently that aesthetics (Madsen, 1998).

Stevens (1934) tested the effect of perception on the intensity of tones. Participants in this study entered into a sound proof room and listened to various tones with different intensity levels and frequencies. The participants could manipulate the intensity of each tone using a dial. They listened to two different tones of varying frequencies and were asked to manipulate the intensity to the point where they thought both tones were at the same volume. The intensities were recorded and analyzed. Results indicated that lower tones were perceived to be louder than higher tones and intensity was enhanced for higher tones and decreased for lower tones to create equal volume perceptions.

Taylor (1976) investigated the effect of experience on the ability to perceive tonality in a short melody. The investigator pretested all participants using a specially designed Melodic Perception Ability Test. This test instructed the participants to sight-sing various melodies, match single tones with their voice, imitate melodies with their voice and identify pitches. Based on the scores of the pretest participants placed into one of three groups. The first group included participants with high scores, the second average scores and the third low scores. Participants then listened to twelve short melodies of varying length, contour and difficulty and were asked to sing the note that they thought was the tonal center for each excerpt. Results indicated that experience was a significant factor. Participants in the high scoring group had the most success identifying the tonal center.

Duke (1989) examined various tone repetitions across a range of stimulus speeds using monotonic stimuli on musicians' perception of beat. Graduate and undergraduate music majors

performed the beat in response to periodic stimulus tones. Nine sets of consecutive tones were presented at various speeds and in random orders. Participants were to listen to each example and tap the perceived beat. Rates greater than 120 tones per minute (tpm) were perceived as subdivisions of the beat while rates slower than 60 tpm were heard as longer sounds than the beat perceived (which acted as a subdivision of the tpm). Most participants performed from 60 to 120 beats per minute regardless of tpm and a rate of 80 tpm was frequently perceived as the actual beat by a majority of participants.

Duke, Geringer and Madsen (1991) tested beat perception as a function of a listener's age and musical training. Participants, representing four age groups (graduate, undergraduate, high school, junior high school) and two levels of music participation (music major/ensemble player and no participation in organized music activities), heard 13 randomized sets of 15-second long tones presented at various tempi (40, 60, 70, 75, 80, 85, 90, 100, 120, 140, 160, 200, and 240 tpm). Participants listened to each segment and tapped their perception of the beat. College music majors tended to respond differently than others. They kept their pulse between 70 and 120 beats per minute. Faster tempos were perceived as multiple sounds within a beat and slower tempos were perceived as longer sounds with the participants' perception of beat being a subdivision of the tone. This was found amongst others in the study as well, but the majority tapped with the tones regardless of speed (especially non-music), while musically trained participants perceived tempi within a defined range.

Johnson, Madsen and Geringer (2012) tested music majors on their ability to manipulate a recording of a piece to see how closely it replicated a professional performance of the same piece. The two studies were identical in everything except stimuli. The first study used Mozart's *Concerto for Horn and Orchestra No. 2,* and the second study used Bach's *Suite Number 3 for*

Violoncello solo, Bourree Number 1. The recordings used were created using finale and had straightforward tempo and rhythmic consistency. After listening to the excerpts, the participants were asked to manipulate the rhythms by using the Continuous Response Digital Interface to make it more expressive (only the tempo/rhythm could be manipulated). The treatment group received instruction after their first creation on the rhythmic tendencies of professional performances of the excerpt and then asked to do the activity again. The control group was only asked to practice with the software before making another recording. Results indicated that the experimental groups manipulated recordings to closely reflect that of the professional recording of the same piece.

Geringer and Madsen (1992) investigated musician's perception of tempo. The participants listened to synthesized percussion sounds, which modulated in tempo from 30 beats per minute (bpm) to 210 bpm at a constant rate of three bpm per second. The decreasing tempo examples were the same with the initial and final tempos reversed. Participants tapped where they though the beat was using the Continuous Response Digital Interface. Results indicated that regions of perceived beat were typically in the range of 60 to 120 bpm.

Geringer, Madsen, MacLeod and Droe (2006) investigated the effect of legato and staccato articulation styles on the perception of modulated tempos. Participants listened to music examples selected from two pieces that had both staccato and legato passages. Excerpts were presented under three conditions: no change, gradual increase or gradual decrease. Results indicated that staccato passages were perceived as increasing in tempo more than legato passages. Differences between the articulation styles were perceived in greater contrast with increasing tempo passages than the decreasing tempo and no change conditions.

Duke, Geringer and Madsen (1988) examined the effect of tempo on music majors' and non-music majors' perception of pitch. Participants heard ten consecutive presentations of an orchestral excerpt. Changing the tempo, pitch or both from the original version altered the ten excerpts and provided a variety of stimuli. The participants were asked to compare each stimulus to the previous and indicate perceived pitch and tempo changes. Results indicated that there was no significant difference between music majors and non-music majors. Changes in tempo were discriminated more accurately than pitch. In addition, tempo changes seemed to affect pitch perception more than frequency changes affected tempo perception.

Sheldon (1994) investigated the effects of listening mode, tempo direction and level of music experience on speed and accuracy in tempo change detection abilities. The examples that participants listened to either gradually decelerated, accelerated or remained steady. Modes of listening included: listening only, listening and watching a conductor or listening while moving. The participants in the study used a Continuous Response Digital Interface to demonstrate their perception of tempo change. Experience was found to be a significant factor. Music majors more accurately detected tempo changes than non-majors. In general, participants detected accelerating tempo better than decelerating tempo.

Fredrickson (1997) studied tension perception and tested participants from a wide range of age groups. Students from grades 2, 5, 8, 11 and 12 all of which had musical training, were tested using the Continuous Response Digital Interface on their perception of tension in a musical excerpt. As with similar studies no definition of the term was given allowing students to come up with their own interpretation. Results found that while students of varying age groups differed in the range of the dial, overall there were striking similarities in the contour of all age

groups. Younger students tended to use the widest range on the dial while older students were more conservative.

Fredrickson (1999) compared the perception of tension in music for people who rehearsed and performed the music with those who have not had the same experience. Students enrolled in a university wind ensemble rehearsed and performed Gustav Holst's *First Suite in E-flat*. Within two weeks of the performance, the participants used a Continuous Response Digital Interface dial to measure their perception of tension in the first movement of the suite while listening to a recording. Similarly, another group of students used the same stimuli but had not rehearsed or performed the work. The study found that the experiences of rehearsing and performing the music had no significant effect on the perception of tension.

Fredrickson (2003) compared music majors and non-majors on their perception of tension in two selections of jazz music. The researcher used the Continuous Response Digital Interface to record the participants' responses to the stimuli. The two selections were versions of *St. Louis Blues* by W.C. Handy. One version was a more popular recording by Nat King Cole and the second was by Ella Fitzgerald. The researcher found that there was no significant difference in the tension perceptions between music and non-music majors.

Madsen (1998) compared musicians' responses while listening to Haydn's *Symphony No. 104* using a two-dimensional Continuous Response Digital Interface. The interface used a mouse cursor on a computer screen as a tool to evaluate the two dimensions being tested. The dimensions that were tested were arousal (relaxing-exciting) and affect (ugly-beautiful). While listening to the recording, participants moved the cursor to the right when they considered the music to be beautiful and to the left when they considered the music to be ugly. Similarly, they moved the cursor up when the music was exciting and down when it was relaxing. Results

indicated an inverse relationship between the two dimensions. Most often participants perceived the exciting-relaxing dimension representing degrees of arousal in opposition from the affective responses. Results indicated that arousal and affect in music represented different aspects of perceived listening.

Approval/Disapproval

Educators in every discipline exhibit teaching behaviors that can either be beneficial or detrimental to the overall learning environment of their classroom. The effectiveness of approval and disapproval feedback for academic and social behaviors is a specific point of interest in educational research. In any given situation, it is important for the teacher to understand which forms of feedback are going to produce the most positive results. This is especially true in music education because often teachers are dealing with numerous students at once. Results indicate that approval and disapproval oriented teacher behavior affected musical preferences (Alpert, 1982; Droe, 2008) and attentiveness (Dorow, 1977). Moreover, results indicate that people perceive approval-oriented teaching as being more effective that disapproval-oriented teaching (Madsen & Duke, 1985).

Droe (2008) tested the effect of teacher approval and disapproval of music performed in a rehearsal setting on the musical preferences of middle school students. Students from eight middle school bands participated in the study and were assigned one of four different rehearsal conditions. Teachers rehearsed either one or two assigned pieces while implementing one of the following conditions: (1) rehearsal of one piece with teacher approval and rehearsal of the other piece without comment (2) rehearsal of one piece with teacher disapproval and the other without comment (3) rehearsal of only one piece with teacher approval and (4) rehearsal on only one piece with teacher disapproval. After five rehearsals students were surveyed and the conditions

had a significant effect on the students' preferences. Approval treated conditions received significantly higher ratings than disapproval conditions.

Alpert (1982) investigated the effects of approvals of various music types (country, rock and classical) attributing to various sources (disc jockeys, peers, and music teachers) on attitudes and listening behaviors on four fifth grade classes. Each class was randomly assigned to a group. Group 1-Three teacher approved classical excerpts; three disc jockey approved country excerpts and three peer approved rock concerts. Group 2- Three-teacher approved rock excerpts; three-disc jockey approved classical excerpts and three peer approved country excerpts. Group3 – three teacher approved country excerpts; three disc jockey approved rock excerpts and three peer-approved classical excerpts. Group 4 – control (no approval). The approvals utilized were identical, and the only change was the person giving the approval. Approvals from all three increased the preference of music as compared to control. Music teachers' and disc jockeys' approvals increased classical music preference while peer approval decreased it. Other music showed no significant difference.

Madsen and Duke (1985) conducted a study where they had students enrolled in music courses watch a video that contained high approval and disapproval teacher behavior. The researchers wanted to investigate the participants' perception of these classrooms given the conditions. Participants were asked to watch the video in its entirety and afterwards were prompted to answer a questionnaire. Questions ranged from asking what the participant thought about the teachers overall behavior, to what they believed was most effective. Results indicated that participants with more behavioral training were able to remember more accurately what happened in the video. Also, most participants viewed the approval oriented teaching as being more effective than disapproval.

Dorow (1977) tested the effect of approval and disapproval oriented musical training on the attentiveness of students at a concert. This study tested four groups of randomly selected 4th and 5th grade students. Two groups received 5 days of instruction—one with high approval and the other high disapproval. The third group attended the pretest concerts but not in the training sessions while the fourth group only attended the posttest concert. Disapproval and approval ratios were controlled so that each group received 80% of either condition during the training period. The music being taught during the training was similar to the piano music during the pre and posttest concerts. The concerts and classrooms were recorded and analyzed for off-task behavior. During the posttest concerts, the students who received the high disapproval treatment were much more off task than the other groups even compared to the pretest.

Dynamics

The musical element of dynamics is one of great importance in the performance practices of musicians. How loud or soft a melodic line is played can completely change the sound, texture and emotional gravity of the music. Music educators must be conscious of the dynamics within the music so that the composer's intentions can be met and the audience's musical experience can be more gratifying. Research on dynamics focuses on how the element is perceived and how it affects the preferences of listeners. Results indicate that crescendos are perceived to have greater volume change than decrescendos (Geringer, 1995; Susini, Meunier, Trapeau, and Chatron 2010) but that decrescendos are detected at a faster rate than crescendos (Geringer, 1991) and dependent on resonating chambers and formants varying instruments have different levels of dynamic ability (Wagner, 1994). Moreover, dynamics affect the perception of tempo and time for both the performer (Hong, 2003) and the listener (Kellaris & Altsech, 1992) and in

general the use of dynamic contrast affects the aesthetic perception of audiences (Burnsed & Sochinski, 1995; Burnsed, 1998; Burnsed, 2001; Gordon, 1960).

Geringer (1995) conducted a study where participants listened to recorded excerpts and reacted to the changing dynamic levels by turning a dial to the right for increasing dynamics and to the left for decreasing dynamics. There were eleven excerpts used in the study. Ten where tested and the first excerpt the participants heard was for practice purposes. Each excerpt had a full phrase of music and had at least one crescendo and one decrescendo. The excerpts were manipulated so that the intensity of each dynamic change was consistent regardless of direction. Musicians taking the test exhibited a smaller dynamic magnitude than non-musicians. Overall, crescendos were perceived as having a greater change in dynamics than decrescendos.

Geringer (1991) tested the ability for musicians and non-musicians to discriminate modulating dynamic intensity by circling "Louder, Softer, or Same" after listening to a musical excerpt. There were three forms of stimuli each with two different versions. The first was electronic tones of the same fundamental frequency; the second was keyboard music excerpts and the third recorded instrumental music. He found no significant difference in the ability to discriminate the intensity changes between musicians and non-musicians. However, participants were able to detect volume decreases sooner that increases.

Hong (2003) analyzed recordings of cellist playing *Saranande* from J.S. Bach's C Major Cello Suite. During this analysis she plotted when each note changed by clicking a mouse along with the rhythm changes. A computer program plotted these changes on a graph automatically while also showing a spectrograph analysis of the pitches and dynamics. She wanted to compare the idea of expressive timing in relation to dynamics utilizing a string instrument since similar studies in the past used primarily piano. Previous studies had shown that when pianists

performed a crescendo they tended to speed the tempi up slightly and when the performed a diminuendo they tended to slow the tempi lightly. Hong wanted to compare these results with that of a cellist. There were no significant differences between the results of her student to that of previous studies, but the correlation with expressive timing and dynamics was consistent to previous findings.

Gordon (1960) analyzed different bands at festival competitions on their dynamic levels performed. Using a recording device the researcher recorded 9 different performances of bands. After the recording was complete, he analyzed the recordings using an oscilloscope to measure the decibel levels of the bands' performances. What he found was that dynamics are relative, meaning that passages that say "forte" are often played at several decibel levels (the same is true for "piano"). Also, the bands that typically received higher ratings were the ones that over emphasized their dynamic contrasts.

Susini, Meunier, Trapeau, and Chatron (2010) tested the perception of dynamic increases based on the focus questions for each crescendo. The stimulus was a 1.8 second increase in sound that was either increased at 15 decibels or 30 decibels overtime. The starting decibel level was different for each dynamic increase. Six stimuli were created for the 15 decibel increase starting at 45, 50, 55, 60, 65, and 70 decibels. Four stimuli were created for the 30 decibel increase starting at 45, 50, 55, and 60 decibels. The stimuli were either performed as either a 1-kHz tone or a synthetic vowel. Each stimulus was presented twice (one for each sound). Therefore, there were 22 1.8s dynamic increases used as the stimuli. Participants were given each stimulus at random and asked to rate the decibel levels. Group one only estimated the overall decibel level; group two estimated the change over time and group three estimated the decibel level at the end of each dynamic increase. Results indicated that group 1 tended to

estimate the global loudness closer to the top of the dynamic increase and that the 15 decibel change was closer to the climax than the 30 decibel range. Group two estimated that change in loudness was higher for the 30 decibel than the 15 decibel stimuli and the loudness change was judged to be more the when the end of the stimulus was louder. The difference for the 15 and 30 decibel estimations was lower for the 1-kHz tone than for the vowel. Group three estimated much higher decibel peaks for the 30 decibel stimulus.

Kellaris and Altsech (1992) tested the effect of volume on the perceived time of a piece. Participants split into two groups and entered into soundproof rooms where they listened to a 3-minute piece of music. One room played the music at 60 decibels and the other at 90 decibels. The researchers also investigated the perceptions of women and men listeners on their estimates of time. Results indicate that louder music was perceived as lasting longer than the softer music. Also, women perceived the music to last longer than men.

Wagner (1994) writes about instruments and how the notes of that instrument respond in different ways based on the overtones they create. For instance, instruments that are able to sound their fundamental frequency have a much different timbre than instruments that do not. It is also suggested that some notes played on various instruments resonate more than others. These pitches are called formants, and he writes that when an overtone falls within or near a formant area the frequency is strengthened. These formants emphasize different overtones in the sound and this gives each instrument its timbre.

Burnsed and Sochinski (1995) investigated the effect of dynamics on musical preferences of middle school students. Participants took a computer administered music preference test where they listened to two versions of ten folk songs incorporating a total of twenty different stimuli. Each folk song had a version that utilized expressive variation in dynamics and one that

remained static. Participants were asked to rank their preferences for each stimulus. Results indicated a significant portion of the students prefer the folk songs that utilized expressive dynamics.

Burnsed (1998) conducted a follow-up study to test the affects of dynamics on elementary students' music preferences. Participants listened to two versions of ten folksongs that were manipulated using the Music Impression Expression computer program, to create a performance with flat dynamics and another with contrasting dynamics following the contour of the melody. Participants preferred recordings with dynamic contrasts for seven out of the ten songs.

In a similar study, Burnsed (2001) used the Music Impression Expression computer program to slightly alter ten folksong recordings to create realistic sounding stumuli. Dynamic contrasts expressed smaller amplitude changes and a higher recording quality than was used in the previous study. Elementary students in grades one to five, middle school students in grades six to nine, and conductors listened to the recordings and circled a preference for hearing subtle dynamic changes or flat dynamics. Results indicated the middle school students preferred one of the expressive recordings, while the conductors preferred five of the ten expressive recordings.

Timbre

Timbre is an element in music that enables humans to differentiate one sound from another by the unique intensity of high and low overtones present in every complex sound. The human voice, a car horn and a violin all have different timbres due to a unique intensity pattern in the overtones of the sound. Research suggests overall changes in intensity can affect the perception of timbre (Haack, 1975) and intonation discrimination improves when comparing sounds with different timbres (Ely, 1992). Moreover, the perception of timbre affects musicians

ability to accurately perceive dark tone qualities to be flat and bright tone-qualities to be sharp (Geringer & Worthy, 1999, Worthy, 2000)—although, this phenomenon happens less for participants with higher musical experience (Geringer & Worthy, 1999).

Haack (1975) utilized the Seashore Measures of Musical Talent aptitude test to investigate the effects of different loudness levels on perception and the discrimination of pitch, loudness, rhythm, duration, and timbre. Thirty questions from the test were selected to cover the multiple musical variables. Each sound file was presented at varying decibel ranges "soft," "moderate," and "loud." During each testing session, the manipulation of amplifier loudness controls created the following stimuli: soft, 45-50 decibels; moderate 75-80 decibels; and loud, 105-110 decibels. Results indicate that the elements of loudness, rhythm, duration and timbre were affected by varying loudness levels. Timbre showed the most significance. It was easier for participants to discriminate the element of timbre at softer decibel levels than louder decibel levels.

Ely (1992) investigated the effects of timbre on collegiate musicians' perception of intonation. The study used stimuli recordings of different pairs of woodwind instruments. Participants were given the task of listening to the pairs and determine if the two sounds were "in-tune" or not. Six recordings were used for discrimination. The instrumental combinations included in the study were flute/flute, clarinet/clarinet, sax/sax, clarinet/sax, flute/sax, and clarinet/flute. Therefore, there were three similar timbre and three dissimilar timbre combinations. Results indicate that participants were able to detect intonation problems with dissimilar timbre combination more accurately than similar timbre combinations.

A similar study by Worthy (2000) investigated the effect of different tone-quality conditions on middles school wind instrumentalists' perception of pitch. Participants included

several middle school students from local band programs. The stimuli used in the study were recordings of various wind band instruments that were electronically manipulated to have a "bright" or "dark" sound. The instrumentalists only listened to sound files of their primary instrument. The experiment asked each student to listen to a recording of a tone and to describe it and determine if it was flat or sharp. Results indicate that the "bright" tone conditions were perceived to be sharp and the "dark" tone conditions were perceived to be flat.

Geringer and Worthy (1999) investigated the effect of different tone-quality conditions on high school and college students' perception of intonation. The stimuli used in the study were digital tones imitating the sound of a clarinet, trumpet and trombone. The original tone quality of these samples was manipulated to create stimuli with both "dark" and "bright" tone-qualities. The manipulated recordings were put into pairs along with the original sound files. This created six pairs of recordings: original/dark, dark/original, original/bright, bright/original, dark/dark, bright/bright and original/original. Participants listened to the stimuli and determined if there were any intonation discrepancies. Results indicate that participants' perceived the "bright" sound files as being sharp and the "dark" sound files as being flat. In addition, participants with more experience exhibited no significant interaction.

Sound Envelope

The sound envelope of a tone includes the attack, sustain and decay. How one hears an envelope and perceives it is an area of interest among music educators. By developing greater understanding of a musical envelope, musicians can better understand how a tone is perceived and how manipulating the conditions of the envelope can change the overall perception of the tone. Research on musical envelope is primarily focused on the removal of the attack and/or release of the tone or tones. Research indicates that by manipulating the envelope it can have an

effect on musicians' ability to identify instrument timbre (Elliott, 1975; Paul, 2005).

Elliott (1975) investigated the effect of attacks and releases on the ability of music majors to detect instrumental timbres. In this study participants listened to reference recordings of multiple instruments (flute, Bb clarinet, oboe, alto saxophone, bassoon, trombone, trumpet, cello and violin) and were asked to identify them. The participants listened to the reference recordings twice. This first part the attacks and releases were removed from the sound envelope and the second part the original envelope was used. Results indicated that during the first part participants were able to identify the oboe, Bb clarinet and trumpet at a significant level. During the second part, the participants identified all instruments, with exception to the cello, at a significant level.

Paul (2005) replicated, in part, the study by Elliott. This study investigated the effects of manipulating sound envelope components on the abilities of high school students to identify wind instruments (oboe, bassoon, Bb clarinet, tenor saxophone, horn, trumpet, trombone, tuba and euphonium). Participants listened to three different stimuli recordings and asked to identify which instrument was playing. The first listening, the attacks and releases of the sound envelope were removed and participants were given no information as to which instruments were performing. The second condition was the same as the first, but a reference list of instruments was provided. The third condition, the participants were provided a reference list of instruments and the stimuli included the attack portion of the envelope. Participants listed the instruments in order they heard them perform. Results of this study indicate the clarinet and oboe were identified correctly most often and the presence of the attack within the envelope increased participants' abilities to identify instruments.

Conducting

In music education, the conductor exhibits an influential role by leading ensembles through rehearsals and guiding musicians' collective interpretation to create or re-create an ideal performance. Performance ensembles traditionally include conductors and this is why it is important for researchers to study how a conductor's behavior affects the performance and perception of music. Results from several studies reveal an ensemble's performance quality affects the perception of the conductor by others (Silvey, 2011) and without a visual representation it is difficult for musicians to recognize when a different conductor is present (Madsen, Geringer & Madsen 2009). At the same time, improvements in rhythm reading and phrasing are observed when young musicians receive conducting instruction (Kelly, 1997).

Silvey (2011) tested the effect of ensemble performance quality on the evaluation of conducting expressivity. The researcher videotaped two conductors conducting one of two excerpts of Ticheli's *Loch Lomond*. These videos were duplicated and synchronized with either poor or excellent performances of the same piece. To determine whether identical conducting would be evaluated differently on the basis of excellent or poor ensemble performance one hundred and twenty musicians viewed each of the four one minute stimuli. During their viewing, they rated the conductor's expressivity and the ensemble's performance quality on a 10-point likert scale. The results found that the performance of the ensemble significantly affected the ratings of the conductor's expressivity.

Madsen, Geringer and Madsen (2009) investigated the effect of multiple conductors and interpretations on adolescent musicians' perceptions. Participants listened to an audio recording of Johann Strauss's *Blue Danube Waltz* twice led by two different conductors. Participants marked how many changes in the musical performance they heard. They then watched a

performance of the same piece and marked how many changes in the musical performance they heard . Results indicated no significant differences among the conditions suggesting they were unable to identify a change in conductors when only presented with audio stimuli.

Kelly (1997) investigated the effects of conducting instruction on the musical performances of beginning bands and students. He pretested eight different beginning bands and the individual students within those bands on their abilities to perform legato, staccato, phrasing, dynamics, and rhythm. Afterwards, the experimental bands received ten minutes of basic conducting instruction at each rehearsal for ten weeks. Students were tested and significant improvements in rhythmic performances were found for students in the experimental bands. The experimental bands also experienced improved rhythm reading and phrasing skill when compared with the control group. Improvements to the performance of dynamics and legato and staccato articulations were not statistically significant.

Music Aesthetics

How people perceive music emotionally is an area of interest to music researchers. Having a better understanding of aesthetics in music helps the music educator know what musical elements impact emotional response the most. The more aesthetically pleasing the music is performed, the more the audience and the students enjoy it. Results from several studies indicate that musical experience is not a significant factor in the ability to perceive aesthetics in music (Madsen, Brittin, & Sheldon, 1993) and the higher the focus of attention on the music the higher the aesthetic response (Madsen & Coggiola, 2001). Moreover, the perception of aesthetics can be negatively affected by pitch modulation (Hancock, 2008; Madsen & Geringer, 2004).

Madsen, Brittin, and Sheldon (1993) tested the aesthetic responses of thirty faculty members and advanced graduate students using the Continuous Response Digital Interface

(CRDI). Participants listened to the last twenty minutes of Act I of Puccini's *La Boheme* and indicated their perception of an aesthetic response using the CRDI. Each participant had slightly different responses, but the general peaks and low points were consistent across all participants.

Madsen and Coggiola (2001) investigated the effect of focus of attention on musicians and non-musicians' aesthetic responses to Puccini's *La Bohème.* Participants split into two groups with one listening to the piece while using the Continuous Response Digital Interface to show their perceived aesthetic response and the other group only hearing the piece. All participants completed a questionnaire after the listening to report their "aesthetic responsiveness." The group manipulating the dial showed higher perceived aesthetic responses than those who did not.

Madsen and Geringer (2004) investigated the effect of a gradual pitch alteration on the aesthetic responses of music majors. Participants split into three groups each listening to a performance of Haydn's *Symphony no 104* and using the Continuous Response Digital Interface to calculate their perceived level of aesthetic response. Group one listened to an unaltered version while the other two groups listened to a performance that gradually increased or decreased in pitch. The total magnitude of the pitch change was 300 cents and occurred at a one cent per 1.2 seconds rate so that it would be difficult to identify. Results indicated that the group with the unaltered recording had a significantly higher aesthetic response to the music than the other two groups.

Hancock (2008) investigated the effect of gradual pitch modulation on the aesthetic response of music and non-music majors. Participants listened to Samuel Barber's *Concerto for Violin and Orchestra, Op. 14* while turning a Continuous Response Digital Interface dial to represent their aesthetic responses. The participants were split into three groups. Group one

listened to the recording with no pitch modulation. Groups two and three listened to the recording with either an ascending or descending pitch center. The pitch moved at a rate of one cent (1/100 of a semitone) per second. Results indicated no significant differences between music and non-music majors aesthetic responses to the original recording. However, music majors had a lower mean score for the ascending pitch condition while non-music majors' mean score closely resembled that of the no change condition. Both music majors and non-majors had lower mean scores for the descending pitch condition.

Attention in Music

The ability to remain attentive is an important concern for all educators. This is especially true in music education where the ability of students to remain attentive to numerous musical elements directly affects their performance abilities. Attentiveness in music, whether holistically or by musical element, is an area of interest for music researchers as well. By investigating the attention of music listeners researchers have a better understanding as to which musical elements garner the most concentration. Research indicates musicians focus their attention on melody while non-musicians focus on dynamics while listening to music (Madsen & Geringer, 1990) and typically melody and dynamics command the highest level of attention for listeners (Madsen, 1997). Moreover, when assessing performances, intonation exhibits an effect on the performance rating (Geringer & Madsen, 1998) and the duration of the performance (Geringer & Johnson, 2007).

Madsen and Geringer (1990) investigated how musicians compared to non-musicians in their listening patterns. They tested 120 participants (60 music and 60 non-music) using a potentiometer, which recorded the amount of time spent on each stimulus listed on the device. The stimuli marked on the potentiometer were melody, timbre, dynamics, rhythm and

everything. Participants moved a lever to one of the markings when focused on that musical element. The times spent on each stimulus were calculated and compared. The researchers found that there were significantly different listening patterns between musicians and non-musicians. Musicians' time spent on each stimulus was ranked in the following order: melody, rhythm, dynamics and timbre. In addition, non-musicians' order of attentiveness was dynamics, melody, timbre, everything and rhythm.

Geringer and Johnson (2007) tested the effects of excerpt duration, tempo and performance level on musicians' ratings of wind band performances. Music majors rated several wind band performances that varied in performance level (high school, professional and university), tempo (fast/slow) and duration (12, 25, 50 seconds). Results indicate there was a significant interaction between duration, tempo and performance level. Ratings were higher for medium and long durations of professional and university groups than the short duration. In addition, medium and long durations were rated lower than the short examples for high school performances. No significant difference was found for tempo with regards to ratings.

Madsen (1997) tested experienced musicians on their attentiveness to various musical elements and how it related to their aesthetic response. All participants listened to the final twenty minutes of Act I of Puccini's *La Boheme.* Fifty of the participants used the Continuous Response Digital Interface to indicate which musical elements (dynamics, timbre, melody, rhythm or everything) commanded their attention during the listening—a colored tab on the interface marked each element. The other fifty participants split into five groups of ten, each focusing only on one of the five musical elements. Participants who tracked all elements simultaneously had the highest percentage of attention for dynamics, followed by everything, melody, rhythm and timbre. The groups who responded to only one element were combined for

observation and exhibited a different ordering. The combined preference order was melody, dynamics, everything, timbre and rhythm. The results of this study were compared to previous studies on aesthetic response and found that melody followed by dynamics had the greatest correlation to aesthetic response.

Geringer and Madsen (1998) investigated which elements of music commanded musicians' attention when rating good and bad vocal and string performances. The participants listened to two excerpts of a soprano, tenor, violin and cello perform. One excerpt was considered performance quality while the other suffered considerably in intonation, tone quality, rhythm, and dynamics. The participants were given a traditional performance evaluation rating scale to assess the performances. Results indicated that the listeners consistently discriminated between the bad and good performances across all rating scales. Intonation was the element most often identified as needing improvement by the participants.

Acoustics

Acoustics in music is pivotal for music educators to understand as the performance environment can dramatically affect the quality of sound that an instrumental ensemble creates. Experienced music educators know how performing outdoors as compared to performing in a concert hall can affect how the ensemble should practice and prepare. Since brass instruments have a tendency to produce more decibel levels than woodwinds and strings, many sound engineers study acoustics in concert halls to try and find solutions to create better balance for wind bands and orchestras (Ballou, 2008). In addition, different acoustical environments can affect an instrumental ensembles performance of dynamic range and tempo (Winckle, 1962).

Winckel (1962) investigated the effect of concert location on the performance quality of an orchestra. The researcher traveled with the Cleveland Orchestra and took acoustic

measurements in fifteen different concert halls. The results revealed that dynamic range and tempo were most affected by change in acoustics. Observations suggest the perceived range of dynamics depends mainly on the ambient noise within the hall and state of sound diffusion. Moreover, the orchestra performed with faster tempos in halls with more reverberation and diffusion.

Ballou (2008) writes that brass instruments produce higher decibel levels when playing at a perceived forte (94-102 decibels) than woodwind instruments (84-93 decibels). Other musical groups that were investigated included string instruments (77-90 decibels), open piano (77-102 decibels), solo singer (80-105 decibels) and choir (90 decibels). This information is important to sound engineers because they develop and construct acoustical environments that will help balance out this imbalance of sound.

Music Pedagogy

Utilizing practical and efficient ways to teach students a musical concept is the main focus of any music educator. Pedagogical methods that are effective and efficient help the classroom-learning environment, which fosters more accomplished and successful musicians. When teaching a concert band crescendo envelope, it is important to review and understand the various pedagogical techniques. For example, some techniques include teaching the crescendo should remain soft then dramatically increase in intensity at the end (Casey, 1991); the crescendo should increase in sound consistently and evenly (Lisk, 2006; Jackson, 2010) and the crescendo should be balanced and voices should crescendo at different times to keep the tonal balance of the ensemble consistent (Jagow, 2007).

Casey (1991) incorporates pedagogical techniques from several prominent music educators and compiles them to give the music educator a handbook on teaching music and band.

In his book, he writes that dynamic levels are relative and pianos and fortes should be played differently depending on context. Factors that determine proper dynamic level are performance range, performing instrument, size of the ensemble and style of the piece. He suggests in regards to crescendos that the majority of the dynamic change should happen at the end of the crescendo and it should start from the lower voices in the ensemble. The overall emphasis is that dynamics must be relative and balanced to be effective.

Lisk (2006), when writing about dynamics, uses the number system to delegate a dynamic level. The first number represents piano or pianissimo and the level gradually intensifies with each increase in number. The interpretation of a crescendo and decrescendo should be gradual between each volume marking. He suggests dynamics should be spoken first by having the students count aloud with the volume changes. This way the students can feel the intensity necessary to create extremes in dynamics. Afterwards, the dynamics are performed on instruments imitating the intensity levels exhibited in the vocal counting. The main focus in this technique is for the ensemble to remain balanced and blended while increasing in intensity.

Jagow (2007) proposes the balanced dynamic approach. She argues that the bands tonal color and balance should remain consistent at all times. In order to accomplish this balance while performing dynamic changes, different instrumental families must approach the change differently. In regards to crescendos, she writes that the low voices should crescendo first, followed by the middle voices then the high voices. This ensures that the low voices maintain the sonority throughout the crescendo.

Jackson (2010) when writing about dynamics discusses the importance of finding your band's peaks at both the loud and soft levels. He uses the band room itself as a guide. The floor represents piano, the middle of the room represents mezzo forte and the ceiling represents

fortissimo. He also suggests the number system where piano is 1, mezzo forte is 5 and fortissimo is 10 with all other dynamics falling in-between. He suggests that crescendos should be gradual and dramatic but even in nature.

CHAPTER 3

METHODOLOGY

This study was designed to examine the following research questions.

1. Does a unison envelope shape performed by all instruments in a concert band affect instrumental music educators' preferences for an ensemble crescendo performed by the wind section of a concert band?
2. Does the practice of using different envelope shapes by instrument section in a concert band affect instrumental music educators' preferences for an ensemble crescendo?
3. Are instrumental music educators' preferences for a specific performance of an ensemble crescendo affected by their experience, career status, or primary instrument?

Participants

Participants (N = 62) were instrumental music educators assigned to one of six experimental groups (n = 10, 10, 10, 10, 11, 11). To conduct the study, I acquired a current list of all members of the Alabama Music Educators Association (January 15, 2013 edition), imported all contact information into an *Excel 2011* (version 14.1.0) spreadsheet, and randomly assigned each member into one of the six experimental groups. An email invitation to participate in the study included a recruitment statement and one of six randomly assigned internet links to a website used to administer the study. See Appendix D. Collection of data concluded after obtaining at least 10 responses for each experimental group. Respondents included *pre-service* (n

= 17), *in-service* (*n* = 41), and *post-service* (*n* = 4), instrumental music educators who primarly played a woodwind (*n* = 35), brass (*n* = 14), or percussion/strings (*n* = 13) instrument.

Stimulus recordings

Creation of sound files. The final tutti Bb chord in Sheldon's *Visions of Flight* was entered into *Finale 2011*, rescored for a duration of eight beats (approximately four seconds), and arranged to sound a Bb dominant 7 with the seventh performed by the alto and tenor saxophone voices. A second chord was composed to create a V^7-I resolution using standard voice-leading rules (Aldwell & Schachtner, 2002). The entire chord and chord resolution lasted for six seconds. See Appendix B for a copy of the score. *Visions of Flight* represented the instrumentation and scoring used in a contemporary grade four concert band composition (Florida Bandmasters Association, Concert Band Literature List), which was confirmed by an expert in concert band pedagogy with 22 years of experience in the field.

A performance of the score with a tempo set at quarter note equal to 120 beats per minute was exported for 23 individual instruments: piccolo, flute, oboe, clarinet (1, 2, 3), bass clarinet, alto saxophone (1, 2), tenor saxophone, baritone saxophone, bassoon (1, 2), French horn (1, 2), trumpet (1, 2, 3), trombone (1, 2, 3), euphonium, and tuba. Instrument sounds were produced using the *Garritan* sound palate included in *Finale 2011* and imported into an audio mixing program (*Sound Studio*, version 4.5.4).

Creation of crescendo envelops. The fade function in *Sound Studio* was used to create three different recordings representing sound envelopes with different degrees of changing intensity and overall shape (See Figure 1):

1. steadily increasing – wedge
2. increasing with plateau – ramp

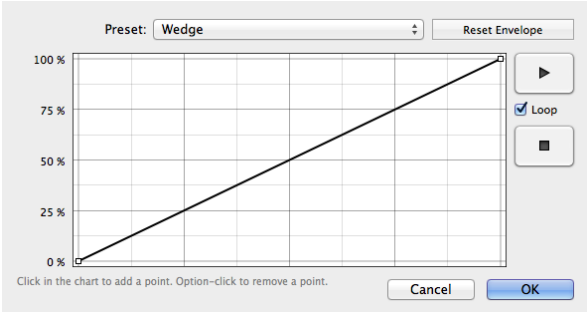
3. increasing logarithmically – bell.

Recordings were arranged into three instrument groups based on musical range of the instruments and combined to create six ensemble performance variations designed to simulate pedagogical approaches to performing ensemble crescendos with concert band ensembles such as a continuous steady crescendo (Jackson, 2010; Lisk, 2006), a bell shaped crescendo (Casey, 1991) and a combined crescendo with some instruments forming a wedge shaped envelope (Jagow, 2007). The combinations of envelope shapes assigned for each recording may be found in Table 1.

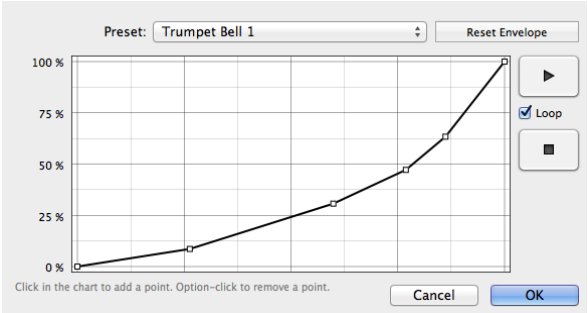
Recording formatting. Each stimulus began with ten seconds of white-noise followed by two seconds of silence to control for participants' comparing versions of the crescendos to one another. Each performance was repeated two additional times to allow participants to have an opportunity to acclimate. Each stimulus followed this pattern: static—silence—crescendo—silence—crescendo—silence—crescendo.

Procedures

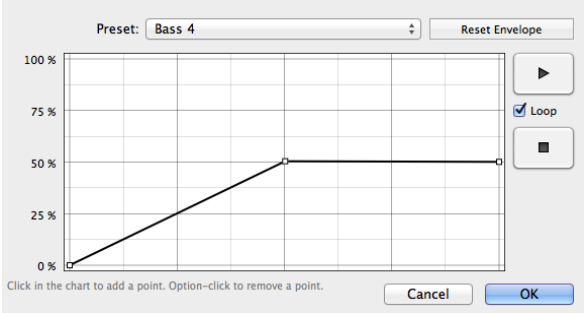
To administer the study, a 15-page research website was created using surveygizmo.com. See Appendix C. The first page of the website included participant consent information, contact information for the researcher and a button designed to indicate whether a participant agreed to participate in the study. The second page included a prompt paragraph stating that the experiment will include listening to an audio stimulus and that the volume on the computer or device used to participate in the study should be on. The prompt also required access to the Internet through a wifi network or wired connection to successfully participate in the study. The requirement was stipulated to avoid the latency and slower download speeds indicative of other types of network connections (e.g., 3G or 4G cellular access) used by some



Wedge shape – gradually increasing intensity.



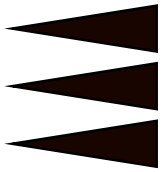
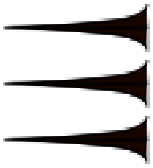
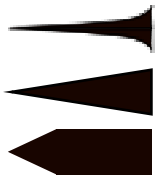
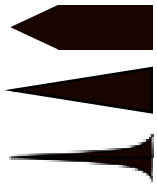
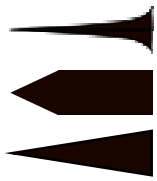
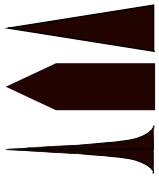
Bell shape – log-linear increase in intensity



Ramp shape – gradual increase and plateau

Figure 1. Shape of crescendo envelopes applied using the fade function of *Sound Studio*.

Table 1
Sound Envelopes Assigned to Instrument Range for Ensemble Crescendo Stimuli

Ensemble crescendo stimulus	Instrument grouping range			Composite envelope shape
	High	Middle	Low	
1	Wedge shaped Steady increase	Wedge shaped Steady increase	Wedge shaped Steady increase	
2	Bell shaped Log increase	Bell shaped Log increase	Bell shaped Log increase	
3	Bell shaped Log increase	Wedge shaped Steady increase	Ramp shaped Increase and plateau	
4	Ramp shaped Increase and plateau	Wedge shaped Steady increase	Bell shaped Log increase	
5	Bell shaped Log increase	Ramp shaped Increase and plateau	Wedge shaped Steady increase	
6	Wedge shaped Steady increase	Ramp shaped Increase and plateau	Bell shaped Log increase	

digital devices. Pretesting of the website revealed the loading of sound files failed to function properly when connected to cellular networks.

The third page included directions on how to calibrate and adjust the playback volume level of the sound files to a consistent and comfortable level for each participant and their playback hardware (e.g., computer, *iPad*). A recording of the researcher reading the following script provided directions.

> *In order to participate in this research study you will need to be able to hear the excerpts provided. Listen to my voice and adjust the volume to a comfortable level. You will be listening to several examples in this study and will need to be able to hear them adequately. Once your volume is adjusted to a comfortable level please do not make any adjustments until after you have completed the study. Thank you for your participation!*

The recording was made using an *Audio-Technica* AT822 stereo microphone with a *Boostaroo* T613 3-channel headphone volume booster and the program *Sound Studio* (version 4.5.4) on a computer running Mac OS X (version 10.8.2).

The fourth page presented an example of a recording to acclimate participants to the timbre of the synthesized concert band. The following script was included.

> *During this study you will be listening to sound files created to replicate a concert band ensemble. This will not be an exact replication. Here is an example of what you will here*. <concert band sample plays>

The fifth page contained instructions describing how to complete the study. The instructions were available on the screen to allow participants to read long with the narration. A definition for an ideal concert-band crescendo was not given so that it would be based on the participants' perceptions. The following instructions were provided to the participants.

> *Thank you for participating in my research study. This experiment examines your preferences for different types of crescendos when performed by a concert-band. You are going to hear six examples of a simulated concert band performing a crescendo. Each example will be played three times. After hearing the example you will rate the crescendo on how closely it resembles an ideal concert-band crescendo using the scale provided.*

You are about to hear the first example. For each example you will hear static before the performance begins.

Pages 6-11 of the research website presented the stimuli and collected participants' responses to the various crescendos noted in Table 1. The order of presentation utilized a balanced latin square design resulting in six unique stimulus presentation orders as show in Table 2; and each group of participants was assigned to one of the six presentation orders. After each stimulus, participants were asked to determine how closely the stimulus resembled an ideal concert band ensemble crescendo and indicated their assessment using a five-point Likert scale (1 - not at all, 2 - not really, 3 - undecided, 4 - somewhat, 5 - very much).

Questions on page 12 and 13 asked participants to provide demographic information about their current status as an educator (pre-service, in-service, post-service), their years employed as a teacher and their primary instrument. An additional question, on page 14, encouraged participants to provide suggestions and commentary. The last page included a message thanking participants for their involvement. See Appendix C. Approval for the project was obtained from the University of Alabama, Institutional Review Board. Copies of the approved protocol may be found in Appendix A.

Table 2

Ensemble Crescendo Stimuli Presentation Orders

Order	First	Second	Third	Fourth	Fifth	Sixth
A	1	2	6	3	5	4
B	2	3	1	4	6	5
C	3	4	2	5	1	6
D	4	5	3	6	2	1
E	5	6	4	1	3	2
F	6	1	5	2	4	3

CHAPTER 4

RESULTS

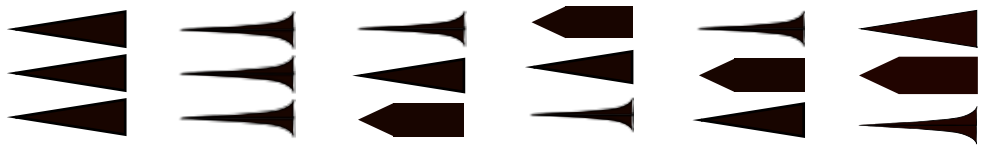
To address the examined research questions, a repeated measures ANOVA with a main effect of assigned experimental condition group, covariate of music teaching experience and a repeated measure of preferences ratings for the six ensemble crescendos was conducted. Mauchly's Test of Sphericity indicated that the collected data adequately met assumptions for the model, $x^2(14) = 16.57$, $p = .280$, therefore no corrections to the degrees of freedom were applied. Within-subjects results indicated the evaluations for the six ensemble crescendos were significantly different from one another for individual participants, F (5, 275) = 3.34, $p = .006$, $n_p^2 = .06$. The interaction between ratings of the six ensemble crescendos and years of experience, F (5, 275) = 1.15, $p = .336$, $n_p^2 = .02$, and the order of stimulus presentation, F (25, 275) = 1.23, $p = 0.210$, $n_p^2 = .10$ were not statistically significant. Between subjects main effects indicated years of experience, F (1, 55) = 0.09, $p = .760$, $n_p^2 = .002$ and the order of stimulus presentation, F (5, 55) = 2.35, $p = 0.053$, $n_p^2 = .18$ were not related to the evaluations of the ensemble crescendos. Table 3 describes the means and standard deviations for the six ensemble crescendo stimuli and highlight the results from a *post hoc* test comparing pairs of means. In general, the rating for ensemble crescendo 2 was significantly different ($p < .05$) from all of the other crescendos. An additional repeated measures ANOVA was conducted to examine the influence of music educators' experience level and primary instrument on participants' evaluations of the six ensemble crescendos. Mauchly's Test of Sphericity indicated that the data

adequately met assumptions for the model, $x^2(14) = 15.12$, $p = .371$, therefore no corrections to the degrees of freedom were performed.

Within-subjects results indicated the evaluations for the six ensemble crescendos were significantly different for individual participants, F (5, 285) = 3.11, $p = .009$, $n_p^2 = .05$, however, no significant interaction effects were present for crescendos X experience level, F (10, 285) = 1.13, $p = .339$, $n_p^2 = .04$ and crescendos X primary instrument, F (10, 285) = 0.47, $p = 0.906$, $n_p^2 = .02$. Between subjects main effects were not statistically significant for experience level, F (2, 57) = 0.76, $p = .473$, $n_p^2 = .03$ and primary instrument, F (2, 57) = 0.04, $p = 0.958$, $n_p^2 = .002$, indicating these variables were not related to the evaluation of the ensemble crescendos.

Table 3

Mean and Standard Deviations for Ensemble Crescendo Preference Ratings

	Ensemble crescendos					
	1	2	3	4	5	6
						
Mean (*SD*)	3.48 (1.18)	4.0 (0.89)	3.23(1.11)	3.26 (1.32)	3.35 (1.13)	3.13 (1.48)

Note. Not underlined = statistically significant post hoc test ($p < .05$) compared to underlined results. Preference options ranged from 1-*not at all* to 5-*very much*.

CHAPTER 5

DISCUSSION

This study examined instrumental music educators' preferences for hearing concert bands perform ensemble crescendos with a particular combination of envelope shapes and whether teaching experience or primary instrument altered these preferences. Results indicated a preference for ensemble crescendos with all instruments simultaneously performing a crescendo with a bell-shaped envelope. In addition, preferences for crescendos with different envelope shapes for different instrument sections showed no significant interactions. Overall, participants' teaching experience, career status and primary instrument did not affect ensemble crescendo preferences.

The crescendo most preferred is an example found in *Teaching Techniques and Insights for Instrumental Music Educators* (Casey, 1991). This crescendo envelope had arguably the most dramatic dynamic effect because the crescendo gradually increased in intensity and then suddenly reached maximum intensity at the end of the performance. Previous research indicates that crescendos are perceived to have greater volume change than decrescendos (Geringer, 1995; Susini, Meunier, Trapeau, & Chatron 2010) and by saving the greatest amount of decibel change for the end of the envelope, the bell-shaped crescendo exhibits the greatest dynamic contrast within the shortest period of time. This finding suggests that musicians may prefer crescendos to sound dramatic and utilize large contrasts in intensity. Previous research supports this concept. For example, Gordon (1960) observed during music performance assessments that adjudicators awarded higher scores to concert bands with the widest dynamic contrast. These findings suggest

the adjudicators preferred the sound of the ensemble that modeled the greatest variety of intensity levels.

Other crescendo envelope shapes examined in the current study were subtle and steady within the timespan of the recording. The ensemble crescendo utilizing the wedge shaped envelope for all voices (Jackson, 2010; Lisk, 2006) showed statistically similar preferential ratings to the crescendos that involved different envelope shapes for high, middle, and low registered instruments (Jagow, 2007). Since preference ratings were statistically higher for the bell-shaped crescendo it implies, given the presentation scenario, musicians prefer a more dramatic crescendo envelope to the other recommended ensemble crescendo practices recommended by pedagogues. This does not suggest one teaching method is superior to another. Music educators, conductors, and performers must decide the context in which to perform these crescendos. There are instances in music where a dramatic approach to performing a crescendo may be inappropriate or unmusical. Likewise, there are musical contexts to where a dramatic performance of a crescendo is advocated and a bell-shaped crescendo envelope is a preferred choice given the results of the current study. This information suggests that contrast, in its most extreme forms, may elicit a pronounced emotional response that instrumental music educators find appealing. To what extent elevated contrast affects preference needs further investigation.

Limitations

The use of electronic sounds to imitate acoustic instruments was a limitation for this study. Previous research suggests that electronic sounds do not accurately represent the tonal differences of live instruments (Williams, 1996) and therefore could have affected participants' evaluations. It is probable that electronic sound sources misrepresent an authentic band crescendo. However, the researcher wanted to control for the influence of other factors such as

balance, blend, intonation, recording equipment and room acoustics, which are difficult to control with live ensembles.

The equipment used to administer the study presented another limitation. A website was used to deliver and compare stimuli and the researcher had no control over participants' playback equipment. Participants who listened to the recordings with headphones probably experienced a better acoustical environment than those who listened with different audio equipment, which can affect volume perception (Wagner, 1994; Winckel, 1962). However, the researcher provided an opportunity for volume adjustment before the study began to minimize differences in listening environment and equipment.

Future Research

There is a need for additional research examining recommended practices and pedagogies for teaching dynamics. This study investigated one concept applied to the sound of a concert band based on several prominent practices for concert bands. A larger variety of performance practices and approaches to teaching dynamic contrasts need to be investigated to determine if these results are common with decrescendos and other dynamic contrasts. In addition, similar studies should investigate these questions with varying attacks and performance envelopes such as a forte-piano. Furthermore, future research should utilize stimuli created by live musicians to facilitate transfers useful for band conductors and music educators. While the use of electronic sounds presented an element of control, it is likely that the tonal changes occurring in a live ensemble affect preferences substantially.

Conclusion

Results from this study indicate crescendos that follow a bell-shaped contour for all instruments in a concert band garnered the highest preference ratings. While preferences are important to understand, they cannot be the only justification for which pedagogies will be utilized in the classroom. It is important to be critical of teaching methods and to be mindful of the purpose of some pedagogical practices is to produce an effect. Regardless of the preferences in this study, it seems important to teach concert band crescendos within a musical context and apply different teaching strategies to elicit a variety of crescendos in performances. Hopefully, results from this study will lead to future investigations on specific performance practices related to ensemble dynamics, which will improve pedagogical practices and more importantly, elicit more musical performances from concert bands.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

February 6, 2013

Office for Research

Institutional Review Board for the Protection of Human Subjects

THE UNIVERSITY OF ALABAMA RESEARCH

Matthew Cicero, M.A.
Music Education
School of Music
The University of Alabama

Re: IRB # 13-OR-044 "The Effect of Manipulating Crescendos on the Perception of the Ideal Band Sound"

Dear Mr. Cicero:

The University of Alabama Institutional Review Board has granted approval for your proposed research.

Your protocol has been given expedited approval according to 45 CFR part 46. You have also been granted the requested waiver of documentation of informed consent. Approval has been given under expedited review category 7 as outlined below:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your application will expire on February 5, 2014. If the study continues beyond that date, you must complete the IRB Renewal Application. If you modify the application, please complete the Modification of an Approved Protocol form. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants. When the study closes, please complete the Request for Study Closure form.

Should you need to submit any further correspondence regarding this proposal, please include the above application number.

Good luck with your research.

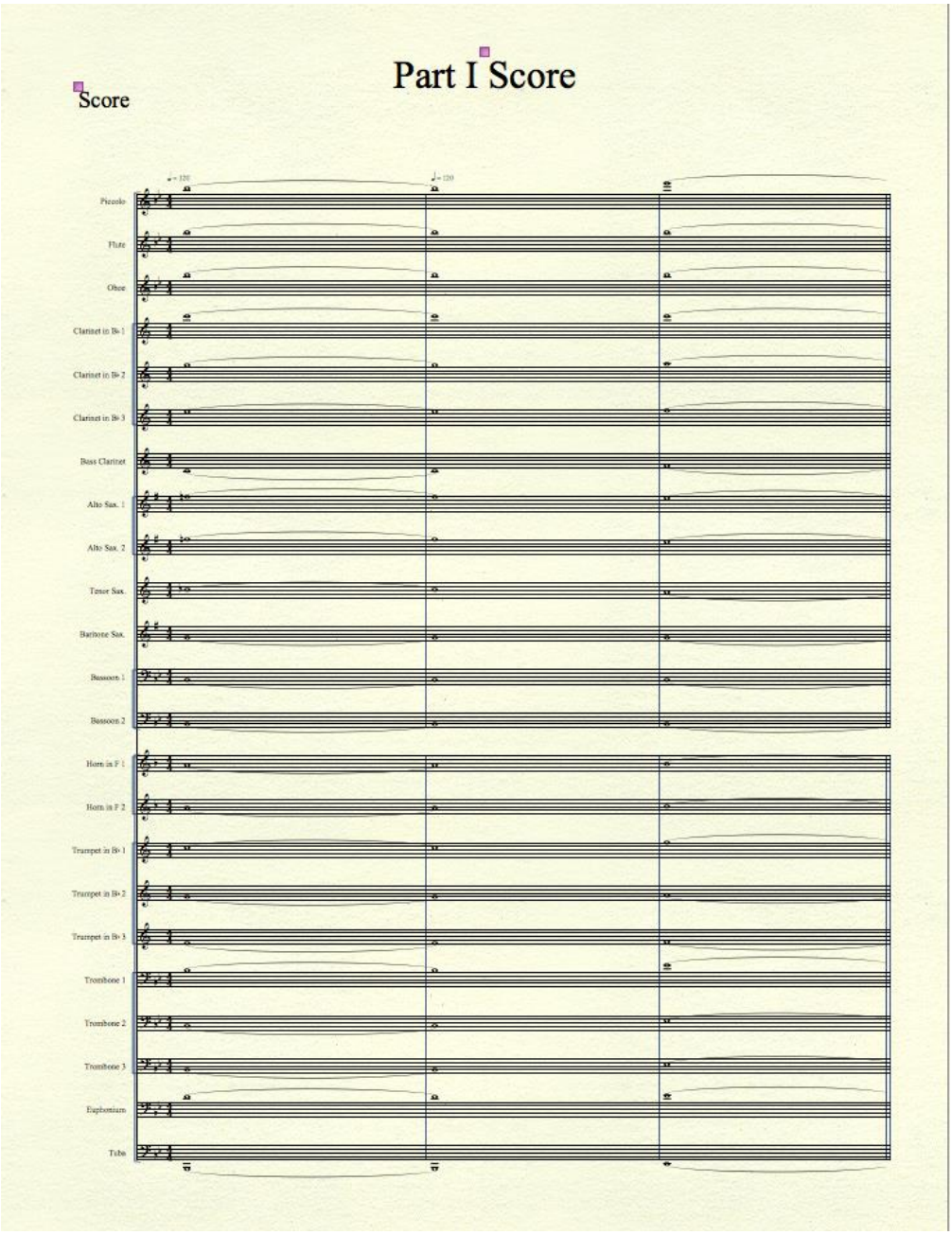
Sincerely,

Carpantato T. Myles, MSM, CIM
Director & Research Compliance Officer
Office for Research Compliance
The University of Alabama

358 Rose Administration Building
Box 870127
Tuscaloosa, Alabama 35487-0127
(205) 348-8461
FAX (205) 348-7189
TOLL FREE (877) 820-3066

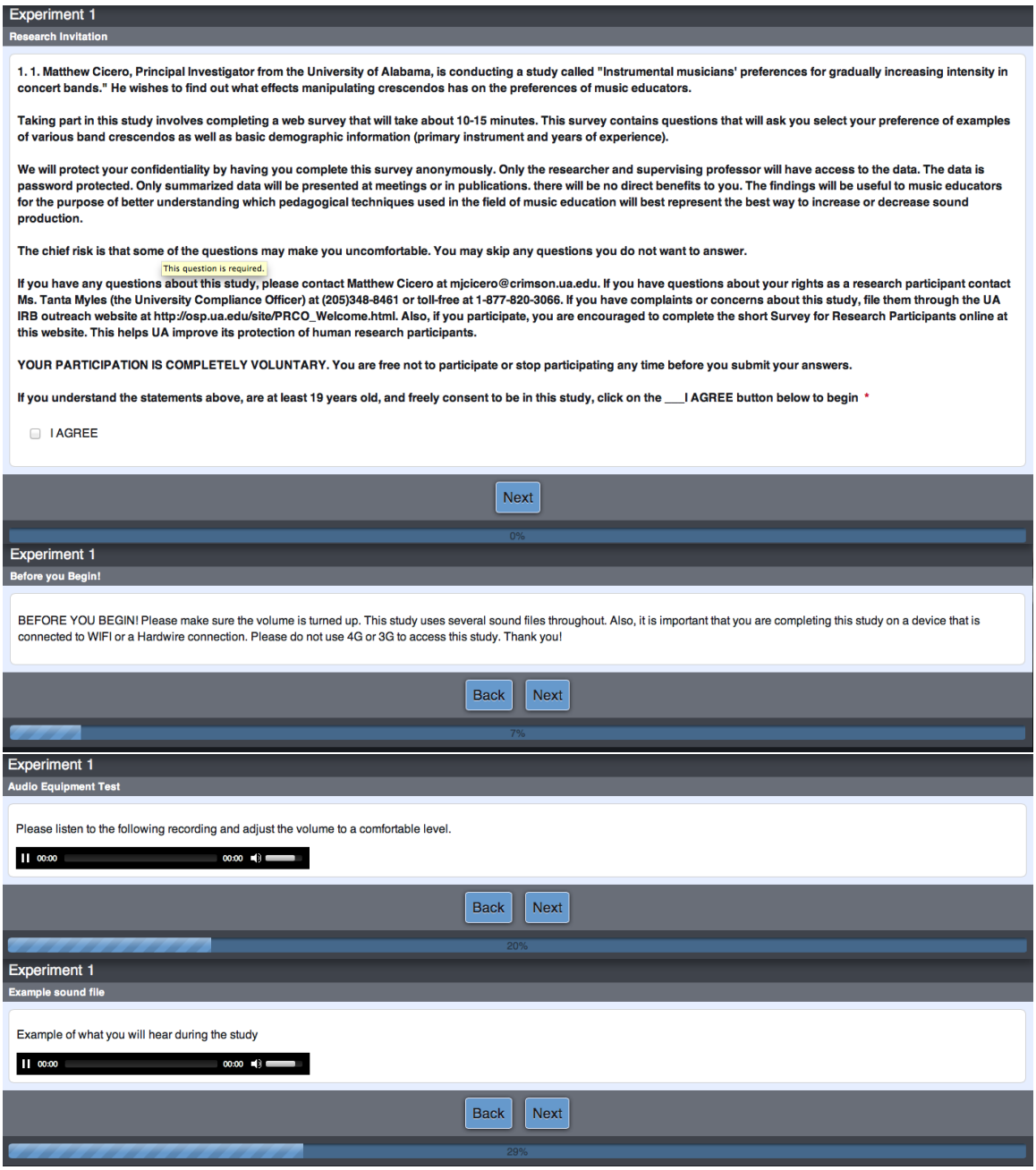
APPENDIX B

FINALE 2011 SCORE FOR EXAMINED CHORD PROGRESSION



APPENDIX C

WEBSITE USED TO ADMINISTER THE STUDY



Experiment 1

Research Invitation

1. 1. Matthew Cicero, Principal Investigator from the University of Alabama, is conducting a study called "Instrumental musicians' preferences for gradually increasing intensity in concert bands." He wishes to find out what effects manipulating crescendos has on the preferences of music educators.

Taking part in this study involves completing a web survey that will take about 10-15 minutes. This survey contains questions that will ask you select your preference of examples of various band crescendos as well as basic demographic information (primary instrument and years of experience).

We will protect your confidentiality by having you complete this survey anonymously. Only the researcher and supervising professor will have access to the data. The data is password protected. Only summarized data will be presented at meetings or in publications. there will be no direct benefits to you. The findings will be useful to music educators for the purpose of better understanding which pedagogical techniques used in the field of music education will best represent the best way to increase or decrease sound production.

The chief risk is that some of the questions may make you uncomfortable. You may skip any questions you do not want to answer.

This question is required.

If you have any questions about this study, please contact Matthew Cicero at mjcicero@crimson.ua.edu. If you have questions about your rights as a research participant contact Ms. Tanta Myles (the University Compliance Officer) at (205)348-8461 or toll-free at 1-877-820-3066. If you have complaints or concerns about this study, file them through the UA IRB outreach website at http://osp.ua.edu/site/PRCO_Welcome.html. Also, if you participate, you are encouraged to complete the short Survey for Research Participants online at this website. This helps UA improve its protection of human research participants.

YOUR PARTICIPATION IS COMPLETELY VOLUNTARY. You are free not to participate or stop participating any time before you submit your answers.

If you understand the statements above, are at least 19 years old, and freely consent to be in this study, click on the ___I AGREE button below to begin *

I AGREE

Next

0%

Experiment 1

Before you Begin!

BEFORE YOU BEGIN! Please make sure the volume is turned up. This study uses several sound files throughout. Also, it is important that you are completing this study on a device that is connected to WIFI or a Hardwire connection. Please do not use 4G or 3G to access this study. Thank you!

Back Next

7%

Experiment 1

Audio Equipment Test

Please listen to the following recording and adjust the volume to a comfortable level.

00:00 00:00

Back Next

20%

Experiment 1

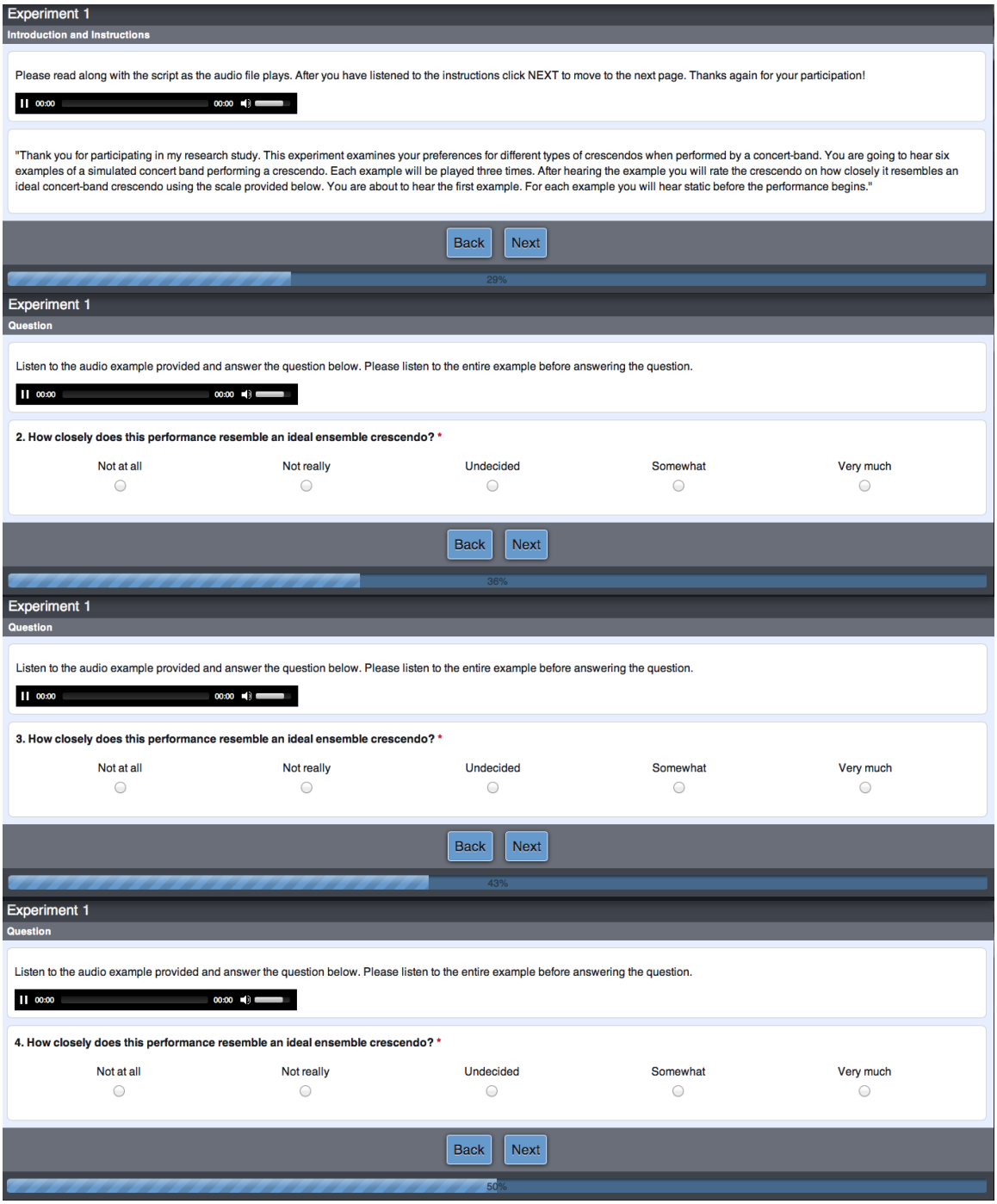
Example sound file

Example of what you will hear during the study

00:00 00:00

Back Next

29%



Experiment 1

Introduction and Instructions

Please read along with the script as the audio file plays. After you have listened to the instructions click NEXT to move to the next page. Thanks again for your participation!

00:00 00:00

"Thank you for participating in my research study. This experiment examines your preferences for different types of crescendos when performed by a concert-band. You are going to hear six examples of a simulated concert band performing a crescendo. Each example will be played three times. After hearing the example you will rate the crescendo on how closely it resembles an ideal concert-band crescendo using the scale provided below. You are about to hear the first example. For each example you will hear static before the performance begins."

Back Next

29%

Experiment 1

Question

Listen to the audio example provided and answer the question below. Please listen to the entire example before answering the question.

00:00 00:00

2. How closely does this performance resemble an ideal ensemble crescendo? *

Not at all | Not really | Undecided | Somewhat | Very much

Back Next

36%

Experiment 1

Question

Listen to the audio example provided and answer the question below. Please listen to the entire example before answering the question.

00:00 00:00

3. How closely does this performance resemble an ideal ensemble crescendo? *

Not at all | Not really | Undecided | Somewhat | Very much

Back Next

43%

Experiment 1

Question

Listen to the audio example provided and answer the question below. Please listen to the entire example before answering the question.

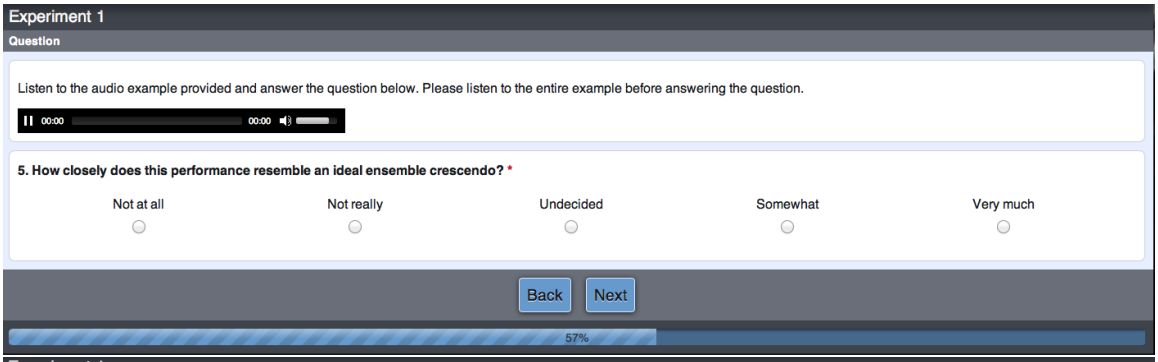
00:00 00:00

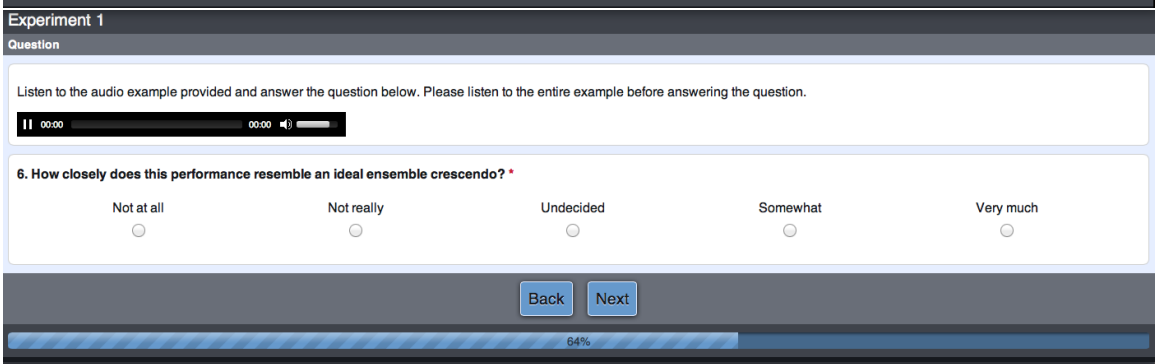
4. How closely does this performance resemble an ideal ensemble crescendo? *

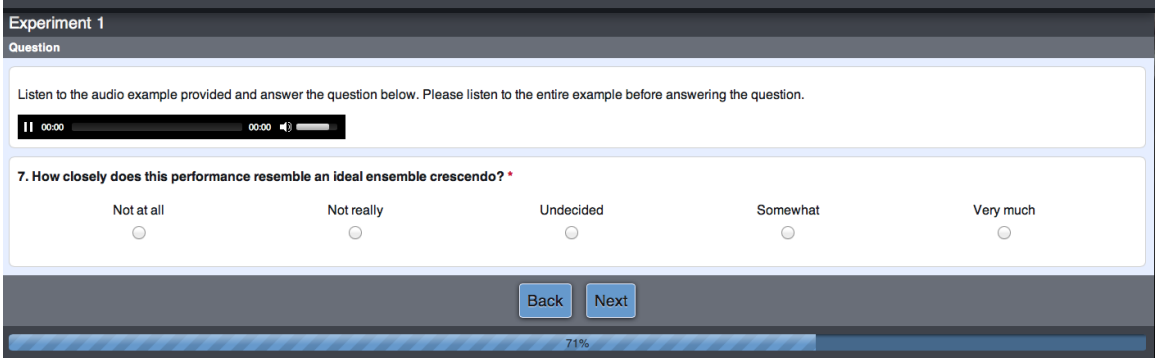
Not at all | Not really | Undecided | Somewhat | Very much

Back Next

50%


Experiment 1
Question
Listen to the audio example provided and answer the question below. Please listen to the entire example before answering the question.
00:00
00:00
5. How closely does this performance resemble an ideal ensemble crescendo? *
Not at all
Not really
Undecided
Somewhat
Very much
Back
Next
57%


Experiment 1
Question
Listen to the audio example provided and answer the question below. Please listen to the entire example before answering the question.
00:00
00:00
6. How closely does this performance resemble an ideal ensemble crescendo? *
Not at all
Not really
Undecided
Somewhat
Very much
Back
Next
64%


Experiment 1
Question
Listen to the audio example provided and answer the question below. Please listen to the entire example before answering the question.
00:00
00:00
7. How closely does this performance resemble an ideal ensemble crescendo? *
Not at all
Not really
Undecided
Somewhat
Very much
Back
Next
71%

Experiment 1

Years of Experience

8. Which of the following best describes you? (you may select more than one if it applies) *

- [ ] College Student
- [ ] Current Music Educator
- [ ] Former Music Educator
- [ ] Retired Music Educator

9. How many years have you been teaching? *

- ( ) Preservice
- ( ) 1-5
- ( ) 6-10
- ( ) 11-15
- ( ) 16-20
- ( ) 21-25
- ( ) 26-30
- ( ) 31-35
- ( ) 36-40
- ( ) 41 or more

Back Next

79%

Experiment 1

Instrument

10. What is your primary instrument? *

- [ ] Woodwind
- [ ] Brass
- [ ] Percussion
- [ ] Piano
- [ ] Voice
- [ ] Other

Back Next

86%

Experiment 1

Comments

11. Comments

Back Submit

93%

Experiment 1

Thank You!

Thank you for your participation! If you have any questions or concerns please feel free to contact me by email at mjcicero@crimson.ua.edu. If you are interested in the results of this study it can be provided by request once the study is complete. Once again, thank you!

100%

APPENDIX D

RECRUITMENT EMAIL FOR PARTICIPANTS

Hello,
My name is Matthew Cicero and I am a graduate student in Music Education at the University of Alabama. I am currently pursuing my Masters degree and working on my Thesis and I need your help with my study!

The benefits for participating in this study include gaining ideas of which pedagogical techniques produce the most desired concert band crescendo, as well as examining what kinds of crescendos directors prefer to hear with their bands. Your participation in this study is voluntary and you will receive no compensation. You can choose to stop taking the survey at anytime. All of your information will be submitted anonymously and only the researcher and supervising professor will have access to the results.

Below is a link to the survey that is being used to collect data. Please take some time and complete this survey. It should not take more than 10-15 minutes.

Thank you for your participation!