EFFECTS OF VOCAL REGISTRATION TRAINING ON THE VOCAL RANGE AND PERCEIVED COMFORT OF THE ADOLESCENT MALE SINGER

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A Dissertation presented to
The Graduate Committee in the Mason Gross School of the Arts
Rutgers, The State University of New Jersey
in partial fulfillment of the requirements for the degree

DOCTOR OF MUSICAL ARTS
Graduate Program in Music Education
written under the direction of Dr. Rhonda Hackworth and approved by

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New Brunswick, New Jersey
December 2009

ABSTRACT

The purpose of this study was to investigate adolescent male vocal registers and repertoire selection for middle school choirs. Subjects included seventh and eighth grade boys ($N = 48$) enrolled in elective mixed choirs at a single middle school in Northern New Jersey. The study was designed to determine (a) the vocal range of subjects before and after vocal registration training, (b) the perceived comfort level of subjects before and after vocal registration training, and (c) the preferences of subjects toward 3-part and SATB arrangements.

Data were collected on the dependent variables of (a) lowest pitch sung, (b) highest pitch sung, and (c) total range sung. Subjects sang 3-part (Treatment 1) and SATB (Treatment 2) choral literature and rated the comfort of each. A concluding attitudinal survey was used to investigate attitudes regarding 3-part mixed and SATB repertoire.

Analysis of variance (ANOVA) revealed a significant increase in total range ($p < .001$). A significant difference in the lowest pitch was observed ($p < .05$) in addition to a significant difference in highest pitch ($p < .001$). No significant differences were found between the two treatment periods on a measure of vocal comfort. Survey responses revealed a significant preference toward SATB music ($p < .001$).

Results replicated Emge (1996), suggesting that seventh and eighth grade boys are capable of singing a wider range than commonly thought possible. Subjects sang both 3 and 4-part arrangements with a general sense of vocal comfort.

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Chapter 1

Introduction

Middle school is a challenging time for many students. Social, emotional, and physical changes during these years contribute to the many difficulties that adolescents confront. Thus, choir teachers in middle schools must consider these challenges when recruiting, teaching, and retaining adolescent male singers. A specific problem for middle school choral teachers involves the individual differences among singers during these years. Phillips (1996) states:

> The voices of boys change at different rates. Some boys never seem to experience a voice break. Their voices may change slowly, and often such boys become adult tenors. Other boys experience a radical and quick change; these most often become adult basses. The biological clock of each boy is different and nature must take its own course in determining the rate of voice change. (p. 77)

Regarding these individual differences, the first problem identified in this study was conflicting research and theories on the male voice change. Phillips and Emge (1994) have summarized the literature into two schools of thought. The first ("School A") believes that the male voice changes slowly and predictably and encourages teachers to choose music within an octave around middle C. The second ("School B") believes that the voice may change at a fast or slow rate in an unpredictable manner and encourages training in various vocal registers. One may consider the English choirboy method as "School C," referring to a period of vocal rest during the overt voice change period. Yet, according to Phillips (1996), "this infamous English voice break has not found much favor in American schools where boys are encouraged to sing during the period of voice change" (p. 45).

The second problem identified in this study was the lack of practical methods and suggestions available to choral teachers. Although much of the research is based on individual voice range and classification, few authors suggest methods for teaching groups of boys in a choral setting. Fewer studies relate the findings of range and tessitura to repertoire selection for the middle school choir.

Choral teachers are challenged further to find appropriate repertoire that appeals to the preferences and attitudes of adolescent male singers. Although style and genre must be considered when programming music for instruction and performance, range and vocal comfort are significant factors. Some middle school teachers may find strength in numbers by placing all boys on the same part, often using 3-part mixed arrangements. These same teachers might be afraid to use SATB literature because the balance and number of boys may be limited. Other teachers prefer SATB arrangements to accommodate the varied vocal ranges of their students. Therefore, the final problem investigated was the lack of direct feedback from students regarding 3-part mixed and SATB arrangements.

Statement of purpose. The purpose of this study was to investigate adolescent male vocal registers and repertoire selection for middle school choirs. Relating to the problems identified, this study replicated components of an experimental design by Emge (1996) to determine if singing in various vocal registers might extend the comfortable singing range of boys. Adding to this experiment, choirs were taught repertoire in 3-part and SATB voicings to compare individual vocal comfort to everyday choral singing. Furthermore, male subjects were surveyed on their preferences and attitudes to provide feedback on vocal registration as it relates to repertoire selection.

Research questions. The present study investigated three problems, each relating to a specific research question. The first problem identified was conflicting theories on the male voice change. "School B" opposes a slow rate of change and advises training in various vocal registers. Therefore, the first research question (adapted from Emge, 1996, p. 12) was:

1. Will vocal registration training account for any significant differences in the total vocal range male students are able to sing?

The second problem related to the lack of practical methods and guidelines for choral teachers, based on research, specifically relating to repertoire selection. The present study aimed to connect findings on vocal registers to appropriate repertoire guidelines for practicing teachers. The associated research question was:

2. Will vocal registration training account for any significant differences in the subjects' perception of vocal comfort while singing 3-part and SATB arrangements?

The final problem addressed in this study was the lack of direct feedback from students regarding 3-part mixed and SATB arrangements. Therefore, the following question investigated the attitudes and preferences of adolescent male singers:

3. Will there be significant differences in the subjects' preferences toward 3-part mixed and SATB arrangements?

Hypotheses. The present study was based on an experimental design with quantitative data to compare two types of choral repertoire for middle school boys. One group was trained in the limited octave around middle C, based on the research of "School A" (Cooksey, 1999; Cooper & Kuersteiner, 1965; McKenzie, 1956). The same

group was then trained and led through various vocal registers as reported by "School B" (Emge, 1996; Mayer & Sacher, 1964; Phillips, 1994, Swanson, 1961). The vocal range of each subject was tested, recorded, and analyzed. Next, subjects recorded their perceived vocal comfort on a semantic differential scale. This is a bipolar research tool that measures a subject's reaction or preference on a scale with contrasting terms at each pole. The present study used the terms "very uncomfortable" and "very comfortable" as the end points of the semantic differential scale. Finally, subjects responded to a survey regarding their attitudes and preferences toward 3-part mixed and SATB literature.

At the outset of the experiment, one assumes that no significant differences will be found. Therefore, the following null hypotheses were directly related to each research question:

H_o#1. There will be no significant differences between means for subjects before and after vocal registration training on a measure of vocal range for total range sung.

H_o#2. There will be no significant differences between means for subjects before and after vocal registration training on vocal comfort while singing 3-part and SATB repertoire as judged by students' perception.

H_o#3. There will be no significant differences in the preferences of subjects toward 3-part and SATB repertoire.

Assumptions.

1. It was assumed that choral music teachers had the ability to test vocal range and place students on the correct voice part.

2. It was assumed that choral music teachers had received ample vocal pedagogy skills to teach breathing, phonation, registration, diction, and mouth position.
3. It was assumed that students would provide honest and accurate responses.
4. It was assumed that students would participate in the entire study while remaining anonymous.

Limitations. The present study was limited to a single middle school in Northern New Jersey with diverse demographics. According to the most recent School Report Card, 49% of the population reported English as the first language spoken at home. Subjects were seventh and eighth grade male choir students who were willing to serve as volunteers. Scheduling was also considered a limitation in this middle school setting. The choirs in this study met five days a week, once a day for 40 minutes. However, choral students who also participated in band or strings received fewer lessons because of instrumental ensemble rehearsals and group lessons. The researcher consequently scheduled procedures to allow full participation of these subjects throughout the duration of this study.

Small sample size was also a limitation in the present study. According to Rainbow and Froehlich (1987):

> Each study is an end product. It is a description of an event that has already taken place. While the description may be systematic and conducted with care, a single observation will neither permit the making of inferences and generalizations nor the drawing of conclusions beyond the studied sample. Many repetitions of the same or similar event are needed to corroborate the results of descriptive investigations. (p. 175).

Definition of terms.

1. Junior High School– generally refers to grades seven, eight, and nine. The phenomenal growth and widespread acceptance of the junior high school during the first half of the 20th century served to remove the ninth grade from the college preparatory influence (Tanner & Tanner, 1995, p. 356).
2. Middle School– generally refers to grades six, seven, and eight. From the 1960's through the 1980's, an increasing number of educators looked to the emerging middle school as being particularly well suited to the task of bridging the childhood phase of elementary school with the adolescent phase of secondary schooling (Tanner & Tanner, 1995, p. 357).
3. Voice Change– refers to the many changes that occur during the period of adolescence called puberty. Occurring most often during the middle school/junior high school years, but sometimes earlier or later, adolescents experience many physical changes, including lengthening and thickening of the larynx and vocal chords (Brinson, 1996, p. 211).
4. Range– refers to the number of pitches (or distance) between the highest and lowest pitches a person can sing (Phillips, 1996, p. 55).
5. Tessitura– refers to the general lie of a vocal part, whether high or low in its average pitch (Phillips, 1996, p. 56).
6. Vocal Register– a group of like sounds or tone qualities whose origin can be traced to a special kind of mechanical (muscular) action (Reid, 1983, p. 296).
7. Vocal Comfort Level– ease of execution (effort) perceived in phonation, either by a subject or another judge (Emge, 1996, p. 16).

8. Passagio– the "passage" from chest voice to head voice (Stroope, 2007).
9. Cambiata– a term by Irvin Cooper and Karl Kuersteiner that refers to a boy's voice in the first stage of change (Brinson, 1996, p. 213).
10. 3-Part Mixed– refers to choral arrangements with three parts. Part I (Soprano), Part II (Alto), Part III (Boys). The range of Part III is typically between F3 and E4.
11. SAB– refers to choral arrangements with 3 parts: Soprano, Alto, and Baritone. The Baritone range is typically between C3 and D4.
12. SATB– refers to choral arrangements with four parts: Soprano, Alto, Tenor, and Bass.

Need for the study. The male changing voice is a challenging phenomenon for middle school choral music teachers, in spite of the abundant research on the topic. Brinson (1996) states that "boys have a much more dramatic experience when their voices change, and possibly for this reason, research in the area of the male changing voice is quite extensive. The knowledge is varied, however, and experts often disagree" (p. 213).

The disagreement among experts justifies the need for more studies on the male changing voice. Although much has been written about vocal range, few studies have provided practical suggestions for middle school choral teachers. The present study investigated vocal range with direct feedback from students regarding vocal comfort and attitude.

Attitudes of middle school boys must be investigated, citing the lack of male participation in music as a problem. Indicating a need for more research, Frakes found

that, “85% of those who dropped out of choral music did so at the junior high level” (p. 103). Consequently, the transition from the young singer to a successful high school choral singer relies on the strength of the middle school vocal program. Swanson (1984) states:

> There is a much more obvious reason for boys to lose their enthusiasm for vocal singing. There is a hurdle boys must meet that girls do not– the voice change. They meet this hurdle in their early teens just when many schools no longer require music but offer it as an elective. (p. 47)

Gackle’s research (1991, 1994) contradicts Swanson’s statement, indicating that females do indeed experience a voice change. However, we may assume that the male voice change is more challenging during the adolescent years, both physically and socially. It is therefore the responsibility of middle school choral directors to keep boys interested in singing as they progress to high school.

Disagreement among teachers was also evident on the topic of repertoire selection for middle school choirs. The issue was complicated further when considering the number of boys enrolled and their perceived vocal comfort. As a result, collegial discussion between middle school choral teachers often included the debate over 3-part and SATB voicings. Janet Funderburk-Galván’s study (1987) found SAB literature to be the “type used most often with choral groups” (p. 68). Although feedback from teachers is important, student input might provide further insight to the problem. Therefore, the present study was needed to gather direct feedback from students and provide practical suggestions for teachers.

Chapter 2

Literature Review

The adolescent male changing voice has served as a subject for research by experts in diverse fields, particularly vocal pedagogy, speech pathology, and endocrinology. In order to apply this research to choral music education, teachers must first consider curricular expectations in public school classrooms. The National Standards for Arts Education (1994) for music in grades five through eight states, "singing alone and with others, a varied repertoire of music" as Content Standard One. Furthermore, Achievement Standards include the directive that students should sing accurately with breath control throughout their singing ranges and perform music written in two and three parts. Similarly, Cooksey and Welch (1998) cite the National Curriculum for Music in England whereby pupils should encounter an increased breadth of repertoire in their singing experiences. They argue that insufficient attention has been paid to individual differences in the adolescent voice, particularly in reference to the National Curricula.

One would hope that research on adolescent changing voices would inform a consistent method of instruction for working with middle school voices. However, Phillips and Emge (1994) identified two basic "schools" regarding vocal ranges among adolescent boys. The following research directly relates to the first problem identified in the present study: conflicting research and theories on the male voice change.

"School A" believes that the boy's voice changes in a predictable manner, lowering in pitch gradually and that voices are limited to a mid-voice tessitura of an

octave or less. McKenzie (1956), Cooper and Kuersteiner (1965), Cooksey (1977), Rutkowski (1984), and Moore (1995) represent this school. In contrast, “School B” states that the boy’s voice may change slowly or quickly, not limited to a mid-voice comfort range of an octave or less. Advocates of this school include Mayer and Sacher (1964), Swanson (1961), Phillips (1994) and Emge (1996).

Current curricular practices encourage singing throughout puberty and the period of change known as mutation. This philosophy contradicts the old English “break” method (“School C”) that advises a period of rest once the voice begins to change. Stubbs (1888) was an early advocate for such vocal rest:

> Mutation affects voices in various ways. Some boys change very gradually; the vocal bands and the parts affecting them developing slowly and evenly. In such cases the boy simply loses his top notes one by one, until his voice settles into tenor, baritone, or bass. Others lose their middle or lower notes first, and afterward the higher notes. There is no certainty about the matter, different voices changing in different ways. Although a skilful voice-trainer can at times so manage a boy's voice that he can sing all through mutation without injury, nevertheless the rule, "Stop singing when the change appears," should seldom, if ever, be disregarded. (p. 76)

Choirboys in the English tradition, according to Phillips (1996), keep “singing totally in the upper voice as along as possible, until the voice breaks, at which time the boys stop singing for a period of adjustment” (p. 45). Although the English “break” method has been disregarded by the inclusive American public schools, one must consider the research from a historical point of view.

Proponents of School A. One of the earliest advocates of the gradual lowering of the male voice was Duncan McKenzie. McKenzie (1956) called his approach the “Alto-tenor” plan and provided a theory that contradicted the traditional “break” method in England. Defining the alto-tenor vocal range, McKenzie suggests a range of notes from

G3 (4th space bass clef) to G4 (2nd line treble clef). He states, "The criterion for determining that the alto-tenor stage has been reached is the ability to sing F3" (p. 20).

Although ages may vary, the alto-tenor stage is associated with seventh and eighth grade boys. McKenzie recommends downward vocalization as the best method of training unchanged voices to form good habits of tone production, preventing use of the chest voice. He adds that as adolescence progresses, boys can sing extra notes in the lower range while the higher notes become difficult to sing. According to McKenzie's alto-tenor plan, boys pass through four stages before proceeding to tenor (see Figure 1).

During the alto-tenor stage, "the voice is still alto, but it has lowered to the extent that the boy can sing in the tenor range" (p. 19). The plan suggests that the adolescent male sing exclusively within the comfortable vocal range.

> If he is taught to realize the importance of singing only in his comfortable range, he will never need to force, and with the music that is today available to suit all the voice conditions in the junior high school, forcing is uncalled for. (p. 34)

Although McKenzie's theory describes a gradual change in the adolescent male changing voice, one notices a contradiction when he states, "either because their voices change to bass quickly, or because their voices pass through the alto-tenor stage during the summer, some skip the classification altogether" (p. 20). While this statement does not generalize his theory, it suggests that some voices change quickly, opposing the belief of School A.

Warren Joseph studied male and female vocal growth during adolescent years. His summary of research (1965) suggests that "vocal growth is a predictable, measurable, and understandable physiological phenomenon" (p. 94). Recognizing the need for data to support his position, Joseph (1966) investigated male and female students ($N = 907$)

between the ages of eleven and eighteen. Vocal range, height, weight, and shoulder breadth were among the physical variables investigated. Although descriptive results were based on means, statistical analysis was not included. Rather, Joseph made broad predictions and correlations between vocal growth and physical attributes without statistical evidence. Similar findings were evident in his replication (1969) with male singers ($N = 119$). Joseph asserts "a high correlation between the factors which cause weight increase and changes in the voice" (p. 425) without statistical proof.

Irvin Cooper and Karl Kuersteiner (1965) described mutational aspects of the voice change corresponding to quality, range, tessitura, and agility of the young male adolescent during puberty in their book, *Teaching Junior High School Music*. They used the term "cambiata" to identify a boy's voice passing through the first change, avoiding confusion with the previous alto-tenor terminology. Like McKenzie, Cooper and Kuersteiner identified four stages for boys, though ranges and tessituras were different. A comparison is drawn in Figure 1.

Cooper & Kuersteiner (1965) acknowledge individual differences by stating, " it is a gross error to assume that every voice in each category fits the prescribed range boundaries, but it is safe to say that the ranges apply in ninety percent of the cases studied" (p. 16). Most cambiata singers appear in seventh grade and are identified by a rich, "wooly" sound, sometimes with the illusion of a lower octave. Cooper (1953) describes this phenomenon further.

> The illusion is caused by confusing timbre with pitch. In its first major change, the voice of the adolescent boy moves down an interval of a fourth from its preadolescent soprano range. The greatest change though, is in timbre, as the voice thickens considerably and presents a temporary illusion to the listener of sounding an octave lower than it actually is. (p. 18)

The usual written tenor part is too low for the singers in this phase, lasting a few months to two years. This range is modified in the second phase to either a tenor or bass quality, yet these voices are not completely changed.

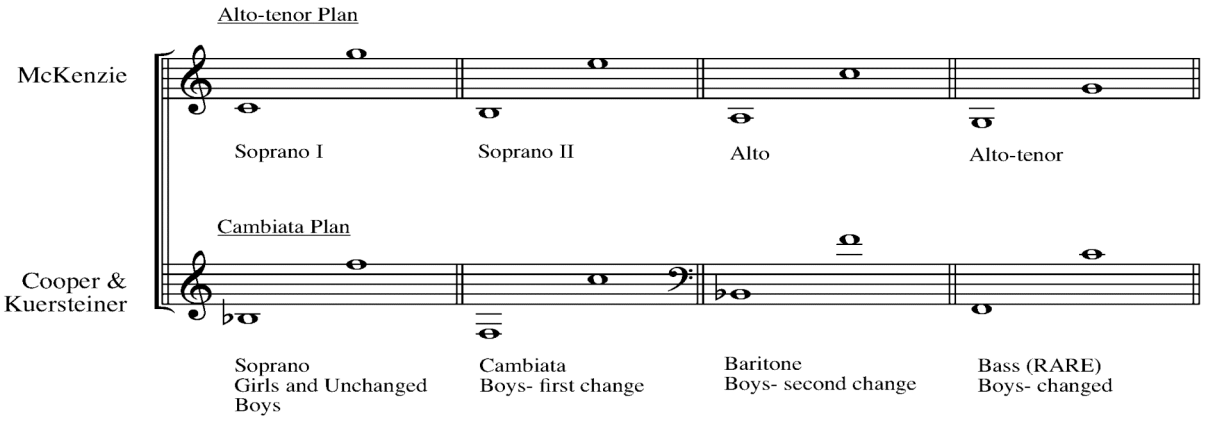


Figure 1. Comparison of McKenzie and Cooper & Kuersteiner's stages

Although Cooper and Kuersteiner (1965) emphasize proper classification of the male changing voice, individual testing is *not* their recommended practice. A six-step group classification procedure is described in their book in addition to a seating plan for chorus. In their conclusion, Cooper and Kuersteiner advocate careful selection of choral literature using range, interesting vocal parts, slow articulation speed, and interesting text as criteria for adolescent singers. Choral literature for the cambiata voice was improved when the Cambiata Press was established in 1972 under the direction of Don Collins, a student of Irvin Cooper.

John Cooksey, a former undergraduate student of Irvin Cooper, is perhaps the foremost authority on the male adolescent voice. In a series of four articles published in the *Choral Journal*, Cooksey (1977 a, b, c, & d) defined his approach as *The*

Contemporary, Eclectic Theory for Training and Cultivation of the Junior High School Male Changing Voice. Cooksey (1977b) proposes:

> Individual variations on the theme are the rule, not the exception in junior high school. These variations, however, do conform to a stable sequence or pattern of events. Thus voice mutation does occur in identifiable developmental stages. It is the rate of change and the entry/exit points of pubertal voice development which are so variable. I consider the factors of range, tessitura, and vocal timbre to be the most important ingredients of each stage of vocal development in the adolescent male. (p. 12)

Cooksey's approach differs from Cooper and Kuersteiner, finding one cambiata stage too restricting in classifying the male changing voice. The purpose of Cooksey's empirical research was to investigate the diverse fields of laryngology, endocrinology, speech pathology, and medicine to offer new insights on the changing voice. These investigations resulted in five maturational stages for the male changing voice including ranges, tessituras, and distinguishing characteristics. Cooksey (1984, 1992, 1999) revised these stages, finalizing classifications as summarized in Table 1.

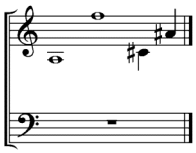
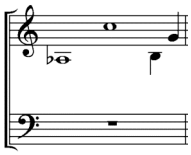
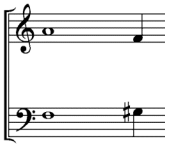
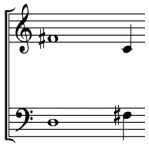
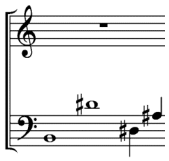
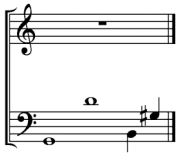
Further investigation of these ranges indicates that the range of Stage II is similar to the single cambiata and alto-tenor ranges of Cooper and McKenzie. Cooksey believes that every male adolescent passes through these stages as the voice gains stability in the low range and upper pitches gradually become unstable. He adds that the majority of mutation begins between ages twelve and thirteen, continuing to an active phase between thirteen and fourteen, finally tapering off between fifteen and seventeen.

Cooksey, Beckett, and Wiseman (1984) conducted a 3-year longitudinal study to determine how certain vocal, physiological, and acoustical factors might define different voice change stages in the adolescent male. Although work was still in progress, Cooksey reported significant results in his presentation at the Symposium on the Male

Adolescent Voice (1984). In this study, seventh grade boys (*N*=86) were tested once a month by vocal, choral, and speech specialists. Vocal factors (range and tessitura), physiological factors (weight and height), and acoustical factors (speaking voice and dynamics) were measured to provide information for an Index of Voice Classification.

Table 1

Summary of John Cooksey's Six Stages for Changes of Voice in the Adolescent Male

Premutation (Unchanged)	Stage I Early Mutation (Midvoice I)	Stage II High Mutation (Midvoice II)	Stage III Mutation Climax (Midvoice IIA)	Stage IV Post-Mutation Stabilizing (New Baritone)	Stage V Post-Mutation Development (Emerging Adult Voice)
					
Age 10-11 Grade 5-6	Age 12-13 Majority Grade 7	Age 13-14 Grade 7-8	Age 13-14 Majority Grade 8	Age 13-15 Grades 8-9	Age 14-15 Grades 9-10
	Average lasts 1-5 months	Average lasts 12-13 months	Average lasts 4-5 months	Average lasts 3-5 months	
Rich, soprano- like quality.	Loss of tonal clarity and richness in upper range.	Huskier, thicker singing voice. Often breathy.	Increased breathiness and strain in upper range. "Pushing" can occur.	Firm sound, still lacking adult sound. Blank spot at middle C.	Developing towards adult quality, lacking tessitura of tenor or bass. Clear falsetto.

Note. Total range notated in whole notes; Tessitura notated in quarter notes

Harris (1993) conducted a similar study including the use of a phonetograph, a chart also described as a voice profile. The purpose was to compare the intensity control

of male singers between the ages of 9 and 17 years, inherently analyzing voices at various stages of mutation. Although his sample size is too small to generalize results (*N*=10), an interesting finding is that "the voices of the ten subjects in this study were evenly distributed among the six stages given by Cooksey" (p. 21). Age was not a reliable predictor of voice classification due to individual differences in physical maturation.

Willis and Kenny (2008) investigated pitch accuracy and intonation based on the findings of Cooksey, Beckett, & Wiseman (1984, 2000). Recordings (*N* = 79) were made by boys between the ages of 12 and 14 using spoken text and performances of *Happy Birthday*. This specific tune was chosen for the study of perfect fourths, fifths, and octaves. Results indicated that the perfect fourth was the most accurately sung interval, followed by the perfect fifth. According to the authors, "boys in all stages of voice change found the octave difficult possibly due to varying vocal range limitations experienced during the changing voice process" (p. 111). However, frequency data was analyzed without testing for statistical significance and cannot be generalized.

According to Cooksey (1984), range was the most effective criterion for classifying the male changing voices in independent stages. Physiological variables of his research reveal a steady increase across the voice change stages, and acoustical data affirmed increased breathiness during the active phase of voice change. Moreover, Cooksey addresses vocal registration as it affects the transition from falsetto to modal (chest) range. Vocal registration was an integral factor to the research of School B and the present study. Cooksey (1984) stated, "I do not believe that one should rely exclusively upon the falsetto register to extend range or consolidate the upper range. It is

most important first to consolidate the modal register, then go for control of the upper range" (p. 41).

Cooksey (1977d, 1992, 1999) offers a thorough methodology for his theory including criteria for selecting repertoire, lists of selected compositions, and procedures for voice classification. He, like Cooper and Kuersteiner, proposes a group classification procedure in addition to individual testing. Rutkowski (1981) offers a thorough description of Cooksey's group voice classification process based on her own teaching experience. Once voices are properly classified, Cooksey believes that repertoire selection must be the core of the curriculum.

Cooksey and Welch (1988) reviewed literature on the adolescent male voice and discussed problems with the National Curriculum for Music in England. Specifically, they criticize curricular repertoire guidelines that offer no criteria or accounting of individual vocal development. They suggest that limitations of range, tessitura, and register must be considered when choosing repertoire, utilizing a suitably limited pitch range. In addition, students should be educated about their voice change and healthy singing habits. The authors state:

> Pupils during KS3 (Ages 11-14), for example, are extremely vulnerable to peer pressure, and are especially sensitive to activities involving the singing voice. It is difficult for adolescents to sing comfortably if they have no real awareness of what is happening to their own changing voices, especially if the singing activity is perceived as "nonessential" by the culture in which it is embedded– or worse still, an "establishment" mandate. (p. 101)

Joanne Rutkowski (1984) attempted to replicate the voice research of Cooksey by investigating the nature and state of change of sixth grade boys (*N*=10) as they progressed through the developmental stages of voice change. At

the end of sixth grade, subjects were tested to determine upper and lower ranges in addition to voice quality and tessitura. The entire procedure was repeated 5 months later in seventh grade, and again at the conclusion of seventh grade. All subjects progressed from fall to spring as expected with the exception of subject 7 who changed to "New Baritone" rapidly. In contrast to the results found by Cooksey, two "Midvoice II" subjects were 12 years old and the "Midvoice IIA" and "New Baritone" subjects were 13 years old (see Table 1). This suggests that some male adolescent singers may enter these classifications one year earlier than previously believed. Conclusions, however, cannot be generalized due to small sample size. Moreover, one must contemplate the possibility of error when relying on a single evaluator.

Rutkowski's research was the basis for Moore's (1995) thesis. The purpose of her study was to determine if the adolescent male voice was continuing to change at an earlier age when compared to previous research. Moore continued Rutkowski's investigation of attitudinal perspectives to determine the extent to which the degree of change in a boy's voice affects his attitude regarding the testing procedure, as will the present study. Seventh grade students (N=60) were chosen from a single school chorus. Subjects were individually tested for upper and lower ranges according to the Cooksey model during class time. Results of this semiannual testing procedure revealed a mean age of 12.8 in the fall and 13.0 in the spring.

Moore's data in the spring showed no subjects in stages I or II as defined by Cooksey, but more than 60% in stages III and IV. Further, Rutkowski (1984)

found no "New Baritones" in the spring while Moore found 8%. This discrepancy may reflect the difference in sample sizes. Moore compares this data to Rutkowski's findings and states that "the adolescent male voice changed at an earlier age when compared with previous research" (p. 19).

The research of Rutkowski and Moore investigated the correlation between Cooksey's voice classification system and chronological age. Harries, Walker, Williams, Hawkins, and Hughes (1997) studied the adolescent voice change within their Pediatric and Linguistic specialties. They investigated a possible correlation between Cooksey's six stages and the five physiological pubertal stages identified by J. M. Tanner (1962). Subjects ($N = 26$) were 12 and 13 years of age and were not enrolled in chorus. Pubertal assessment, salivary testosterone levels, and musical performances were recorded and measured on five occasions over a 12-month period. Specific musical and acoustical recordings included spoken passages, descending musical scale patterns, and a performance of *Happy Birthday*.

Results indicated a significant change in speaking and singing frequencies between Tanner's pubertal stages. These changes were not consistent with those identified in Cooksey's research. The authors suggest that the significant difference is "minimized by Cooksey's use of six rather than five stages" (p. 447). An additional finding by Harries et al. was the maximum vocal change (overt voice breaking) that occurred between pubertal stages III and IV, rather than at the onset of puberty. Nevertheless, "the use of acoustic parameters and the Cooksey classification indicates that measurable changes are taking place earlier

in puberty before the development of overt voice breaking" (p. 447). Implications of this study confirm Cooksey's gradual change in the adolescent male voice and encourage music teachers to identify subtle changes that precede the voice break.

Included among these subtle changes is hoarseness of the speaking voice. Fuchs, Fröehlich, Hentschel, Stuermer, Kruse, and Knauft (2007) investigated the speaking voices of adolescent boys ($N = 21$) to predict mutational changes. The strengths of this study include a 3-year longitudinal duration with participants who were between the ages of eleven and fourteen. Data collection began with unchanged voices and concluded when the overt voice break had occurred in all subjects. Data was collected and analyzed by ear, nose, and throat specialists at 3-month intervals throughout the study's duration.

Concluding vocal analysis was based on the *Goettingen Hoarseness Diagram* (GHD) and audio recordings of each speaking voice. Scatter plots and regression lines were represented for each repeated measure, indicating a significant change ($p < .05$) "at a cutoff point 6-months before the beginning of the mutation" (p. 174). Implications support a belief of School A, deeming the adolescent voice change as predictable. Fuchs et al. believe that their results "support established methods to predict the remaining time that a boy will be able to sing soprano/alto and spare the singer's daily vocal strain before onset of mutation" (p. 175). Although this 3-year longitudinal study is commendable, one must consider the small sample size and note that it would be difficult to replicate without access to practitioners with similar acoustical expertise.

Proponents of School B. Proponents of School B believe that the male adolescent voice may change slowly or quickly, not limited to a narrow comfort range. When reading the research of School B, vocal registers become a significant factor for classifying and teaching changing voices. Mayer and Sacher (1964) challenged the idea of a limited vocal range. They proposed:

> Developing voices are always capable of expression in a much wider range than is now held possible, and that the practice of limiting the range for these voices to an octave or less is in itself harmful and improper. (p. 4)

Mayer and Sacher cite isolation of vocal registers (singing only within the midvoice range) as the major problem with adolescent singers. Agreeing with School A, they describe huskiness in singing and speaking voices during the change period, but recommend the cultivation of this new sound.

> To ask the boy to continue to use only the upper register is like asking him to throw a ball using only 3/4 of the length of his arm, because his arm was only that long when he threw successfully in the sixth grade. (p. 7)

Mayer and Sacher studied boys at a summer camp (1964), all at the age of twelve. There, they found five boy altos who could sing A below middle C. After instruction in their lower register, these same singers could perform D below middle C; a fifth below in a day's time. Although these findings lack a statistical foundation, they suggest that vocal registration may have an effect on singers. This idea was replicated by Phillips and Emge (1994). Moreover, Mayer and Sacher disagree with Cooper and Keursteiner's cambiata approach (1965) as it stresses the upper register with an improperly taught lower register. Their suggested tenor range (D-flat, third line bass clef to G, second line treble clef) is based on the range that the male voice will be going toward. Both schools agree that it is difficult to fit every voice into the standard SATB choral arrangements.

Mayer and Sacher (1964) advocate frequent, individual voice testing with part adjustments made accordingly. How practical is this in everyday classrooms when concert schedules often invade our teaching? Is it possible for students to learn new parts to accommodate their changing voices when preparing for a performance? These questions continue to be a point of debate among middle school teachers.

Frederick Swanson (1961) was the leading proponent of School B during the 1970's and 1980's. Providing the most noticeable contrast to School A, Swanson states that basses with the ability to sing low G (first line bass clef) are quite common in middle school. These observations were based on actual case studies whereby 12-year-old boys were singing in the low register bass clef range happily and easily. Noteworthy, in the 12-13 year old bracket, approximately 30 basses were found out of every hundred enrolled in general music classes. Advocating training in both upper and lower registers, Swanson (1981) stated:

> How exciting it is the first time the teenager displays <u>two</u> voices! He can sing comfortably down in the bass clef range and also in the upper reaches of the treble clef, but he may not be able to produce by any means whatsoever the tones which lie around middle C. (p. 32)

Swanson (1984) describes the fallacy of School A and the assumption that voice change is an orderly, predictable process. He questions why larynx growth must be predictable when growth of height and weight is not. Therefore, Swanson's theory describes the frequent cases where voices dropped in pitch suddenly, perhaps as dramatically as two octaves. This can occur over a small span of six weeks while still retaining the treble voice. His approach has been called the "Adolescent Bass" and it also describes the use of "pulse" registers, "fry" tones, and "Russian Bass" sounds. According to Swanson (1984),

> The Russian Orthodox Church allowed no instruments in their church buildings and all singing was a cappella; if a deep bass was wanted for the choral ensemble, it had to be sung. Therefore, choir directors sought out and developed voices that could sing in the octave below the standard bass clef. (p. 49)

Moreover, Swanson states that this range, an octave below the standard bass clef, appeared in many cases of adolescent male singers. "As a result, some boys who have been labeled deficient, considered flawed nonsingers, have turned out to be valuable assets" (p. 49).

One should note, however, that Swanson is describing deep bass tones that are produced naturally, lacking artificial manipulation of the voice. Richard Miller (2000) describes the Russian Bass system that is based on elongating the vocal tract through laryngeal depression, sometimes accomplished through a deep yawn position. He believes that "the most logical answer to the question of how one increases the lowest part of a young male singing voice is to suggest that his teacher avoid early attempts to do so" (p. 52).

Another vocal register Swanson describes is the "male alto" or "falsetto tenor." In this category, boys continue to sing treble voice and keep these tones after the mature voice has appeared. Overlap in registers may occur, including the ability to sing five or six whole tones around middle C in either register. In conclusion, Swanson (1981) warns that "each changing voice follows its own individual and unique patterns as it moves from the boyish treble to the adult singing voice" (p. 32). Teachers must be innovative and willing to transpose or re-arrange vocal parts to meet these individual differences. The primary criticism to Swanson's theory is the potential harm the application of his

principles may do to the changing voice. The mere ability to sing these low tones does not justify their use from a pedagogical perspective.

Reid (1983) stated that the range is divided into areas called "registers" which may be defined as a group of like sounds or tone qualities whose "origin can be traced to a special kind of mechanical, muscular action" (p. 296). The three vocal registers commonly referred to are head, middle (midvoice), and chest (modal). Cooksey (1984) proposed that the modal register be developed first. Opposing Cooksey, Mayer and Sacher (1964) recommend instruction of the lower and upper registers during the male adolescent voice change.

Mayer and Sacher (1964) influenced Phillips and Emge (1994) to replicate their "experiment" in an empirical design. The purpose was to determine the vocal ranges of seventh and eighth grade boys prior to and immediately following a brief period of vocal register training. Subjects were seventh (N=26) and eighth grade (N=26) boys enrolled in two different junior high school choral programs. Short interviews were conducted to record ages before high and low pitch ranges were tested. The investigators then discussed the vocal maturation process, demonstrating a "lower wheelie" sound, described as an automobile engine with a dead battery. Subjects imitated the sound on a low rolling pulse to experiment with the lower chest register. Subjects were then taught to find their head register by imitating a siren demonstrated by a vocal glissando. Following these imitations, the subjects were tested using the same procedure as the pretest.

Results revealed a total range gain of 4 half steps for seventh graders and 5.0 half steps for eighth graders. Results of paired t tests on pretest and posttest vocal ranges

indicate significant differences, averaging a higher and lower vocal pitch on the posttest and an overall increase in vocal range from pretest to posttest. This suggests that instruction in the upper and lower registers has a significant effect on upper, lower, and total ranges of adolescent male singers. Phillips (1996) states:

> Boys with changing voices need to abandon their prepubertal mixed voices in favor of a two-register production [see Figure 2]. If both registers are well supported and firmly established, the adolescent boy will shift easily between these voices, without the strain so often noted in the top voice. (p. 51)

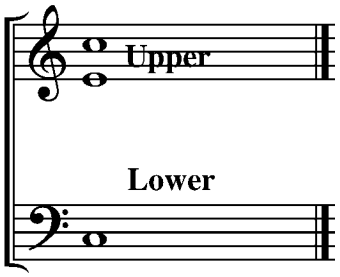


Figure 2. Adolescent tenor ranges for junior high school as defined by Phillips (1996)

Steven Emge (1996) initiated further investigation of vocal registers in his doctoral thesis. The purpose was "to investigate the effects of vocal registers on measures of singing performance among eighth grade adolescents" (p. 12). The study sought to determine if students were capable of singing comfortably in all three registers (upper, middle, and lower), and if these registers could extend their singing range with acceptable vocal sound. Subjects (*N*=62) were eighth grade males from three different junior high school choirs. They were separated into two groups– the first being previously taught under the cambiata approach (School A) and the second being taught with tenor and bass sections (School B). Subjects were tested three times between September 1994 and May 1995. The degree of registration was assessed by tape recorded performances of *America* (first phrase) at three pitch levels (G3, C4, G4).

Subjects and judges rated each performance on a semantic differential Scale ranging from very uncomfortable to very comfortable.

Results of this study indicate that adolescents may be capable of increasing total singing ranges through education in different vocal registers. His findings support the wider singing ranges proposed by the researchers of School B. Although the group taught under the cambiata approach revealed the biggest increase in total range, both groups significantly increased total singing range in this study. Emge's purpose and methodology are the driving principles in the present study. He concludes (1996):

> Judges' ratings and students' self-evaluation reveal that adolescent boys may be capable of singing comfortably in upper, middle, and lower tessituras through the utilization of upper, middle, and lower vocal registers. Therefore, limiting boys to a mid-range voice part may be unnecessary in many junior high school situations. (p. 85)

Results of School B research indicate that ranges may be increased with proper instruction of three vocal registers (high, middle, and low). Patrick Freer (1998) suggests that "boys who develop the skills of mixing the head and chest registers prior to the voice change are often more successful in mixing the registers that occur during and after the change" (p. 36). School B authors believe that voices may change slowly or quickly and do not conform to distinguished stages of mutation. Swanson's (1961) research had important implications for the proponents of School B, describing the rapid change to adolescent bass and tenor. These findings summarize the belief of School B that junior high school male singers need not be limited to a vocal range of an octave but are capable of singing traditional tenor and bass parts.

Research on adolescent singers in choral ensembles. There seems to be a lack of practical methods and guidelines for choral teachers based on research. The views of

School A and School B are outwardly different, but a closer look reveals similar themes. Although McKenzie (1956) advocates a comfortable range in his theory, an extended range could become comfortable with proper training. Furthermore, proponents of School A believe that voice change is a predictable process of gradual lowering. McKenzie, however, warns that some students do change rapidly, sometimes skipping the alto-tenor classification altogether: a statement resembling the belief of School B.

Proper voice classification provides a vital foundation for success in choral ensembles. Although both schools advocate individual testing, Cooper and Kuersteiner (1965) provide a realistic group testing process for typical school settings. Their practical suggestion is to use a group testing procedure during class time, using personal time for individual testing when possible. Students could be scheduled before or after school or during lunch periods for a brief vocal "check-up."

Mayer and Sacher (1964) suggest frequent testing, adjusting placement in vocal parts accordingly. While this is a valid suggestion, one may question how practical it is in a performance-based program. Students cannot learn and memorize music quickly enough to prepare for upcoming concerts if they constantly change parts. A suggestion is to keep them on a comfortable part, perhaps rearranging pitches when necessary.

The previous studies discussed vocal comfort in a physical sense with implications for proper placement in a choir. A different point of view is observed in Kennedy's (2004) qualitative ethnography, investigating vocal comfort in a social context. To avoid embarrassment, choral directors often place all boys on tenor, baritone, or bass parts. Kennedy concludes, "socially this might seem to increase boys' comfort

level and encourage male participation, but vocally, it is misguided" (p. 279). However, she promotes exploring all vocal registers if there is careful monitoring by the teacher.

Few studies have addressed choral repertoire selection within the context of individual voice changes and testing. Hamann (2007) surveyed middle school choral teachers ($N = 32$) to investigate demographics, middle school philosophy, and choral curriculum influences. Results were not conclusive and no significant patterns emerged from the data. However, "the most frequently articulated curricular concern ($n = 7$) for the choir teachers in this sample was the need for better literature, especially literature written for the male changing voice" (p. 69).

Janet Funderburk-Galvan (1987) surveyed 44 junior high school choir directors, twenty years prior to Hamann's survey. Participants were divided into "performance-successful" and "performance-active" groups by the researcher as evidenced by contest ratings and specified criteria. A significant difference was found between groups in regard to the number of years the teachers had taught in the school at the time of this study. Post-hoc analysis revealed that the "performance-successful" group had taught significantly more years at the school studied ($p < .01$). Galvan's survey results also offer an annotated list of 178 compositions that teachers found "ideal for junior high school mixed choruses" (p. 70).

Similarly, Terry Barham has published books that include annotated repertoire suggestions for different middle school voicings. His earlier work (1991) was based on "classroom experiences buttressed by broad-based research findings" (p. 7). A more recent edition (2001) was based on a survey of middle school choir teachers ($N = 60$), chosen by leaders of the Southwestern Division leaders of American Choral Directors

Association (ACDA) and MENC: The National Association for Music Education that included "a list of 236 graded and annotated compositions grouped by voicing" (p. xi). Although Barham refers to statistical analysis in the Appendices of his books, one finds frequency data based only on percentages.

Killian (1998) examined possible relationships between choral contest ratings and voicings of the literature performed. Choirs ($N = 147$) participating in a 1997 Texas choir festival served as subjects in this study. Results indicated that "significantly ($p < .01$) more of the seventh and eighth grade choirs who performed SATB music were judged superior than seventh and eighth grade choirs with other voicings" (p. 40). Additionally, a significant correlation ($p < .0001$) was found between a high ratio of boys in the choir and superior ratings. The implications of Killian's study suggest that 3-part mixed and SAB voicings would lead to less successful ratings than the performances of SATB literature.

Hook (2005) investigated the vocal agility of adolescent males as a factor on repertoire selection. Participants were male choir students ($N = 58$) from grades five through nine who sang a stepwise song pattern in increasing tempi with and without lyrics. Vocal agility ratings were analyzed along with the independent variables of lyrics, tempo, and experience. Additionally, each participant was assigned to a stage according to the theories of Cooksey (1999) and Cooper & Kuersteiner (1965). Results of a Repeated Measures Analysis of Variance (ANOVA) revealed no significant differences in the vocal agility of participants by their classified stage of voice change. However, agility scores were significantly higher with lyrics ($p < .05$) and slower tempi ($p < .05$).

Demorest and Clements (2007) investigated factors that influenced the pitch-matching skills of adolescent male singers ($N = 60$) in grades six through nine. Aural pitch matching was measured using *Pitch Matching Perception Test* (PMPT) software. Vocal tests included single-pitch matching and context-pitch matching within a tonal context. Finally, subjects were classified as either certain, uncertain, or inconsistent singers based on established criteria. ANOVA results revealed a significant difference ($p < .01$) in perceptual scores between groups. However, no significant differences were found by singing range. Implications of this study indicate that vocal range is not a factor on pitch-matching skills of adolescent males. Participants scored significantly higher ($p < .05$) on the context-pitch matching test. Choral teachers may consider these findings when assessing inconsistent singers by providing a tonal context pattern to improve pitch-matching ability.

Summary. Theories on the male changing voice are difficult to generalize due to the varied rates of change and physical characteristics among adolescent boys. When summarizing research of on the male changing voice, the following points emerge:

1. There are two schools of thought regarding the limitations of the male changing voice. School A believes that boys should be limited to a mid-voice tessitura as their voices lower gradually. School B contrasts this limited range view, encouraging development of vocal registers.
2. Both schools believe that boys should sing throughout their maturation period, unlike the English choirboy tradition ("School C").

3. Voice change occurs at the onset of puberty, typically active between ages twelve and fifteen. When teaching in a junior high school, teachers should expect to find voices in many different stages of growth.
4. Although both schools disagree about how predictable the voice change process is, they agree that the rate of change varies for each individual.
5. Most published choral repertoire is inadequate for the male changing voice, specifically in a middle school choral setting.
6. Proper voice classification is necessary, utilizing individual and group testing procedures.
7. Grouping adolescent voices in a choral setting is troublesome due to irregular growth rates. Age should not be the main criteria for grouping; accuracy relies on range, tessitura, and vocal quality.
8. Research of School B suggests that instruction of vocal registers may increase the total singing range of adolescent male singers.

Chapter 3

Method

The present study sought to determine the perceptions and attitudes of seventh and eighth grade boys while singing 3-part and SATB repertoire. Additionally, data was examined to determine if these students were capable of singing extended ranges or were limited to a mid-voice comfort range.

Subjects. Subjects included seventh and eighth grade boys ($N = 48$) enrolled in elective mixed choirs at a single middle school in Northern New Jersey. The inclusion of seventh and eighth grade boys was based directly on the research of Phillips and Emge (1994). They found that seventh and eighth grade boys could "significantly increase their singing ranges, both upper and lower ($p < .001$) after a brief period of vocal registration instruction" (p. 16). John Cooksey (1992) stated that the "most active phase of change occurs on the average between 12.5 and 14 years of age, but there are many exceptions to this" (p. 12). The typical age of subjects in this study ranged from 12 to 14. Each of these singers was assigned a subject number to assure his anonymity.

The demographic distribution of subjects by grade, voice part, age, and musical experience is found in Table 2. According to results of the anonymous survey (see Appendix F), 82% of the participants sang in their elementary school choir before singing in this middle school. Furthermore, 86% participated as instrumentalists in the school band or string orchestra at the time of this study. These percentages suggest a high level of interest and participation in choral and instrumental music among the subjects.

Table 2

Demographic Distribution of Subjects

Category	Grade 7 n=23	Grade 8 n=25	% of total (N=48)
Voice Part			
Tenor	17	12	60%
Bass	6	13	40%
Age			
12	7	0	15%
13	16	7	48%
14	0	17	35%
15	0	1	2%
Instrumentalists	19	23	88%
Elem. Choir Members	19	21	83%

Setting. The subjects attended a middle school with approximately 900 students in grades six, seven, and eight. A diverse population was identified in this school, based on the 2007 *New Jersey School Report Card*. Less than half of the population indicated English as the language spoken at home (49%). Although several languages were represented, the most frequent after English were Spanish (29%) and Tagalog (10%). Additional reasons for the choice of setting included researcher familiarity and music department enrollment. Specifically, this middle school was part of a comprehensive K-12 music department that featured a large enrollment in band, strings, and choir.

The choirs at this middle school were elective and met once a day for 40 minutes. However, the seventh grade choir (N=72) and eighth grade choir (N=76) included students who doubled on instruments in band or strings and split their time between the two ensembles. Instrumentalists in this study were therefore given release time from band or strings to participate fully in this study.

Teacher. The researcher was the choir teacher in this middle school setting. She had been teaching in the district for 11 years, including 8 in this middle school. The use of one setting and teacher was chosen to avoid conflicts in personality, ability, and experience, reducing skewed results. One may compare the approach of this teacher to the framework of "School A" discussed in Chapter Two. The majority of music taught by this teacher included 3-part and SAB literature that limited the boys to a mid-voice comfort range. However, the rationale for these voicings was based on a relatively small number of boys enrolled in each choir. The debate over choir enrollment and vocal range was identified as a problem in Chapter One. Subsequently, the need for this study included direct feedback from students relating to vocal comfort, range, and voicing.

Duration. The present study featured an experimental design that included two treatment periods. The duration of this study was 6 weeks during the Spring 2009 semester. The first 3 weeks included a pretest for vocal range and perceived comfort, followed by instruction of standard 3-part choir literature based on the tenets of School A. This also served as the first treatment in the design (Treatment 1). The subsequent 3 weeks included instruction in various vocal registers as a period of treatment, utilizing new warm-ups, vocalizes, and SATB choral literature based on the tenets of School B.

During this second treatment period (Treatment 2), the subjects were divided into tenor and bass sections, as opposed to previous instruction on one part.

The purpose of each treatment was to determine if differences could be found from instruction in vocal registration during a short period of time. Posttest data was collected at the end of both treatment periods. Finally, each subject completed a survey after the six-week study to gather attitudinal data.

Data collection. The first portion of data collection sought to answer research question one: *Will vocal registration training account for any significant differences in the total vocal range male students are able to sing?* Therefore, the study began with a vocal range test to determine the highest and lowest pitches that the students were able to sing comfortably. The method of vocal range testing was replicated from Emge's study (1996). The researcher facilitated range testing, utilizing audio recordings of each student.

Subjects were tested individually at the beginning of the study. The researcher warmed-up each singer using a piano and the exercises located in Appendix B. Each subject sang a descending, 5-note pattern (scale degrees 5, 4, 3, 2, 1; syllables *sol, fa, mi, re, do*) on an "*ah"* vowel. This exercise repeated, descending by half-step. The student indicated the lowest pattern that they were able to sing comfortably. That lowest pattern, in addition to the previous two patterns, was sung again and audio recorded by the researcher. These three patterns, descending by half-step, were used to determine the lowest pitches each student was able to sing according to their stated comfort level.

The upper range was tested next using the exercises found in Appendix B. Each subject sang an arpeggio (scale degrees 1, 3, 5, 3, 1; syllables *do, mi, sol, mi, do*) on an

"*ah*" vowel. This exercise ascended by half-step as a vocal warm-up. The student indicated the highest pattern that they were able to sing comfortably. That highest pattern, in addition to the previous two patterns, was sung again and audio recorded by the researcher. These three patterns, ascending by half-step, were used to determine the highest pitches each student was able to sing according to their stated comfort level.

The resulting audio recordings were used to determine the highest and lowest pitch each student was able to sing. Three outside evaluators were chosen to listen to the recordings and select the highest and lowest pitches they believed each subject was able to sing. The judges received copies of the testing exercises found in Appendix B in addition to the Vocal Range Data Sheet in Appendix C. This chart, adapted from Emge (1996) lists all pitches from C_2 to B_5. Each pitch was assigned a number for analysis purposes: $C_2 = 1$, $C\#_2 = 2$, and so on. After listening to the recordings, evaluators circled the lowest and highest pitches they believed each subject was able to sing.

The three outside evaluators were certified vocal music teachers who taught choir in New Jersey public schools at the time of this study. They each had at least 10 years of music teaching experience, including successful sponsorship of All-State, Region, and County Choir students. Successful sponsorship implied experience in preparing and adjudicating singers for acceptance in honor choirs.

Individual vocal range testing was repeated as a posttest at the end of both treatment periods. The testing procedure used in the pretest was replicated to determine highest and lowest pitches that the students were able to sing comfortably.

The second research question involved the perception of vocal comfort as identified by students. Specifically, the question asked: *Will vocal registration training*

account for any significant differences in the subjects' perception of vocal comfort while singing 3-part and SATB arrangements? The students were taught three published choral selections in 3-part voicing during the first treatment period. Instruction of these selections referenced the tenets of School A, placing all of the boys on a mid-voice part. The specific choral selections are listed in Table 3.

Table 3

Choral Selections Taught

Title	Composer	Publisher	Year	Voicing	
				Treatment 1	Treatment 2
A Jubilant Gloria	Mary Lynn Lightfoot	Heritage	2003	3-part	SATB
Inscription of Hope	Z. Randall Stroope	Heritage	1994	3-part	SATB
I am the River	Amy F. Bernon	Heritage	2008	3-part	SATB

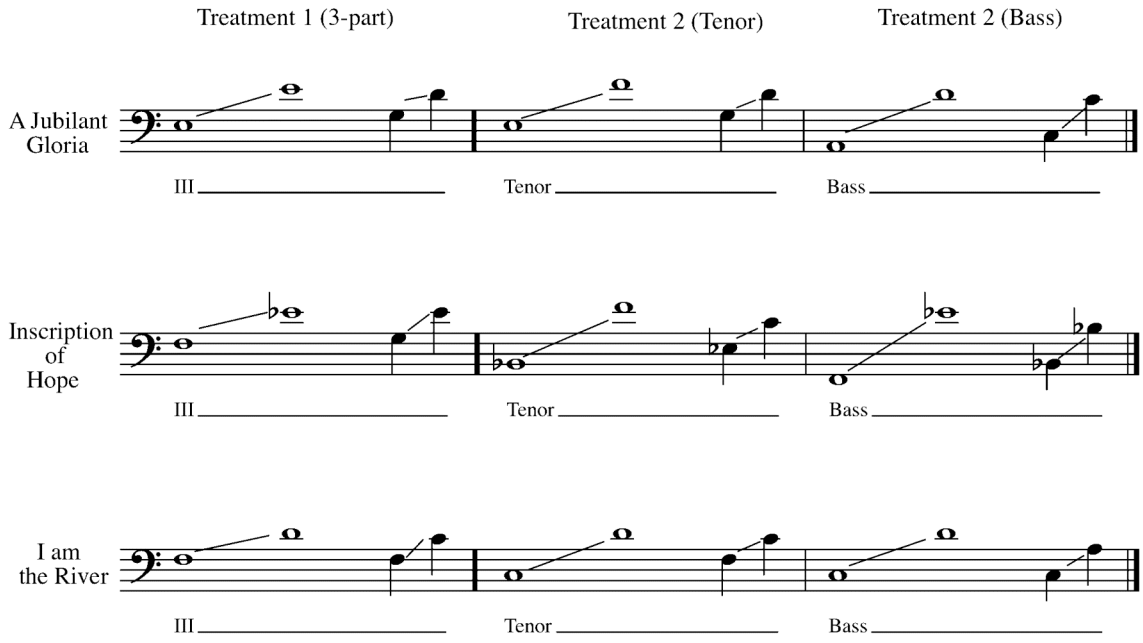
At the end of the three weeks, subjects were given a 5-point semantic differential score sheet to rate their comfort level for each song (see Appendix D). The left pole was labeled *very uncomfortable* and the right pole was labeled *very comfortable*. The students were given the following instructions:

> Place an X on a line to indicate your level of comfort while singing each song. A mark in the center indicates a neutral feeling of vocal comfort. A mark on the left indicates more effort and greater discomfort while singing. Therefore, a mark on the right indicates less effort and more comfort while singing.

The next three weeks involved a second period of treatment in this experimental design. First, the instructor divided the subjects into tenor and bass sections based on

individual ranges that were reported in the pretest. Next, the students were taught specific vocal exercises that utilized various vocal registers. The exact exercises are found in Appendix E, adapted from Stroope (2007). These exercises were chosen to identify and experiment with the chest voice, passaggio, head voice, and falsetto. Approximately 10 minutes of each 40-minute rehearsal was devoted to instruction in these vocal registers.

Throughout this second treatment period, students were taught SATB versions of the same choral selections taught during Treatment 1 (listed in Table 2). The use of identical compositions with different voicings eliminated additional variables that might have skewed the results, such as student preference toward musical style. A comparison of range and tessitura for each selection and voicing is illustrated in Figure 3.



Note: Total range notated in whole notes; Tessitura notated in quarter notes.

Figure 3. Comparison of ranges and tessituras for choral selections

To investigate perceptions of vocal comfort while singing SATB repertoire, students were given another semantic differential score sheet. At the end of this 3-week period, subjects rated their level of vocal comfort on each song using the same instructions in Treatment 1. The vocal range testing procedure used in the pretest was also replicated to determine highest and lowest pitches that the students were able to sing comfortably.

The final research question asked whether vocal registration training would account for any significant differences in the subjects' preferences toward 3-part mixed and SATB arrangements. Therefore, each subject completed an online survey at the conclusion of the study to investigate attitudes regarding 3-part and SATB repertoire and overall treatment procedures. The website used for surveying students was password-protected and access was only granted to participants in this study. Each subject completed the survey in an on-site computer lab at the school, facilitated by the researcher. The survey (piloted for readability and clarity by ninth grade male singers in the same school district) included 14 Likert-style questions for quantitative data analysis (see Appendix F).

Table 4

Summary of Methodology

Treatment 1 Phase	Treatment 2 Phase
1. Pretest for individual vocal range	1. Division into tenor and bass sections
2. Instruction of 3-part choral selections	2. Instruction in various vocal registers
3. Vocal comfort rating	3. Instruction of SATB selections
4. Posttest for individual vocal range	4. Vocal comfort rating
	5. Posttest for individual vocal range
	6. Concluding attitudinal survey

Data analysis. The purpose of data analysis in the present study was to determine if significant differences were found for vocal range and comfort, before and after treatment. An Analysis of variance (ANOVA) test was used to analyze the data for total vocal range. The pitch numbers determined by evaluators were averaged to identify mean pitches for highest and lowest notes sung. The span of pitches between these two means was also analyzed to determine the average range sung by the sample. Data analysis therefore compared the means for highest note, lowest note, and total range sung after two periods of treatment.

Vocal Comfort data was analyzed using a Spearman rank order correlation test. The mean score reported on each 5-point semantic differential item was analyzed for both treatment periods. Spearman rank order correlation measures the relationship between two variables. Specifically, the two variables analyzed were vocal comfort ratings from Treatment 1 and Treatment 2.

Survey responses were presented as frequency data and percentages in table format. Additional statistical analysis was completed using a Pearson Chi-Square test to determine if differences existed between seventh and eighth-grade subjects. Inter-judge reliability was also analyzed to determine the extent to which judges agreed on highest and lowest pitches sung.

Chapter 4

Results

The purpose of the present study was to investigate adolescent male vocal registers and repertoire selection for middle school choirs. The study was designed to determine (a) the vocal range of subjects before and after vocal registration training, (b) the perceived comfort level of subjects before and after vocal registration training, and (c) the preferences of subjects toward 3-part mixed and SATB arrangements. Subjects were seventh (n = 23) and eighth grade (n = 25) boys enrolled in elective choirs at a single middle school.

Descriptive statistics. Data were collected on the dependent variables of (a) lowest pitch sung, (b) highest pitch sung, and (c) total range sung. Vocal range was measured on three different occasions throughout a 6-week period (Pretest, Treatment 1, and Treatment 2). Subjects received training on various vocal registers in Treatment 2 while learning SATB choral arrangements. Unfortunately, five subjects were either absent or unable to match accurate pitch at one or more of the three testing periods. Therefore, vocal range data on these five subjects were discarded and the sample size was reduced. The final sample for vocal range testing (N = 43) included seventh (n = 21) and eighth grade (n = 22) boys as reported in Table 5.

Table 5

Subject Distribution for Vocal Range Testing

Category	*N=43*
Age	
7th Grade	21
8th Grade	22
Total	43
Voice Part	
Tenor	28
Bass	15
Total	43

Highest and lowest pitches sung were recorded and analyzed by three outside judges for all treatment periods. Inter-rater reliability was found to be significant ($p < .01$) using a Pearson Product Moment Correlation, as illustrated in Table 6.

Table 6

Pearson Product Moment Results for Inter-Rater Reliability

Trial	*R*		*p*
	Highest Pitch	Lowest Pitch	
Pretest	.99	.97	.000*
Treatment 1	.99	.99	.000*
Treatment 2	.99	.99	.000*

Note. * $p < .01$

The means, standard deviations, and corresponding pitches for the population are reported in Table 7 for the dependent variables (lowest pitch sung, highest pitch sung, and total range sung). Means for highest and lowest pitches were reported with numbers for the purpose of analysis (see Appendix C) for each testing occasion (Pre, T1, T2). Therefore, the total range indicates the number of consecutive half-steps sung.

Table 7

Sample Means and Standard Deviations for Vocal Range

		($N = 43$)		
	Trial	*M*	*SD*	Pitch
Low Pitch	Pre	13.04	4.382	C_3
	T1	12.26	4.481	B_2
	T2	12.1	4.346	B_2
High Pitch	Pre	31.75	5.091	G_4
	T1	33.01	5.048	$G\#_4$
	T2	36.96	6.279	C_5
Total Range	Pre	18.713	5.845	C_3- G_4
	T1	20.744	6.178	B_2- $G\#_4$
	T2	24.861	6.483	B_2- C_5

Note. Total range = 1.00 – 48.00 ($C_2 – B_5$)

The independent variables examined in this study were grade (seventh and eighth) and voice part (tenor and bass). Table 8 provides a comparison of means, standard deviations, and corresponding pitches for seventh ($n = 21$) and eighth grade ($n = 22$) subjects.

Table 8

Means and Standard Deviations for Vocal Range by Grade

		Grade 7 (n = 21)			Grade 8 (n = 22)		
	Trial	*M*	*SD*	Pitch	*M*	*SD*	Pitch
Low Pitch	Pre	15.67	2.848	$D\#_3$	10.53	4.17	Bb_2
	T1	14.52	3.309	D_3	10.11	4.484	A_2
	T2	14.13	4.046	$C\#_3$	10.17	3.852	A_2
High Pitch	Pre	31.6	5.194	G_4	31.89	4.823	G_4
	T1	32.76	4.913	$G\#_4$	33.24	4.944	$G\#_4$
	T2	36.24	6.429	B_4	37.65	5.399	$C\#_5$
Total Range	Pre	15.94	4.352	$D\#_3$-G_4	20.71	5.218	Bb_2-G_4
	T1	18.24	3.965	D_3-$G\#_4$	22.57	6.646	A_2-$G\#_4$
	T2	22.11	5.266	$C\#_3$-B_4	27.10	6.444	A_2-$C\#_5$

Note. Total range = 1.00 – 48.00 (C_2 – B_5)

Voice part was the second independent variable examined. Descriptive statistics for tenors (n = 28) and basses (n = 15) are therefore reported in Table 9.

Table 9

Means and Standard Deviations for Vocal Range by Voice Part

		Tenor (n = 28)			Bass (n = 15)		
	Trial	*M*	*SD*	Pitch	*M*	*SD*	Pitch
Low Pitch	Pre	15.18	3.727	D_3	9.044	2.138	$G\#_2$
	T1	14.42	3.796	$C\#_3$	8.244	2.422	G_2
	T2	14.21	3.719	$C\#_3$	8.156	2.096	G_2
High Pitch	Pre	33.33	5.09	$G\#_4$	28.8	3.666	E_4
	T1	34.55	5.216	Bb_4	30.13	3.219	F_4
	T2	38.88	5.556	D_5	33.38	6.133	$G\#_4$
Total Range	Pre	18.16	6.546	D_3- $G\#_4$	19.76	4.247	$G\#_2$- E_4
	T1	20.13	6.995	$C\#_3$- Bb_4	21.89	4.242	G_2- F_4
	T2	25.67	6.212	$C\#_3$- D_5	25.22	7.174	G_2- $G\#_4$

Research question one. The first research question asked if vocal registration training would account for any significant differences in the total vocal range that males were able to sing. The means reported in Table 7 increase over the three trials (18.713, 20.75, and 24.861 respectively) as illustrated in Figure 4.

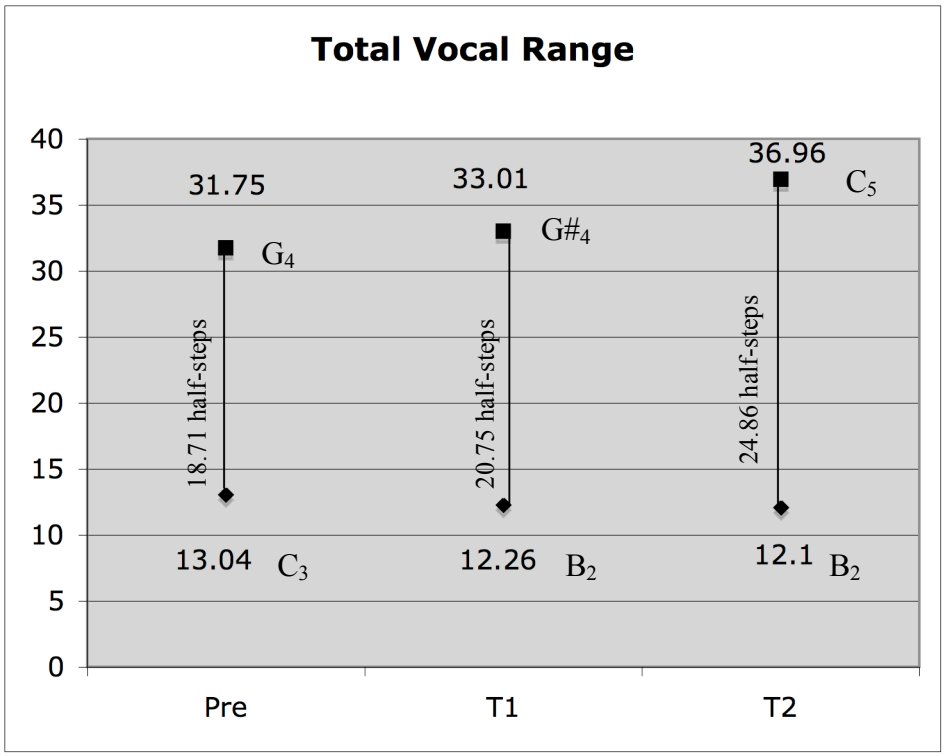


Figure 4. Total vocal range over three trials

The increase in total range observed in Figure 4 indicates a wider span of half-steps that the students were able to sing. Results of a Repeated Measures Analysis of Variance (ANOVA) in Table 10 were therefore analyzed, revealing a significant difference among groups F (2, 78) = 29.242, $p < .001$ for total range sung. Tukey post hoc analysis (Appendix G, Table 18) indicated significant differences for the entire sample after each treatment period. No significant differences were found between vocal parts for total range sung. However, significant differences existed between grades F (1, 39) = 9.982, $p < .01$. Specifically, eighth graders had a greater increase in total range sung than seventh graders at this level of significance. There were no significant interactions for total range sung with any other factors.

Table 10

Repeated Measures ANOVA with 2 Between-Subject Factors (Grade and Part) for Total Vocal Range

Source	*SS*	*df*	*MS*	*F*	*p*
Between Subjects					
Grade (Gr)	804.239	1	804.239	9.982	0.003*
Parts (P)	14.061	1	14.061	0.174	0.679
Gr*P	18.488	1	18.488	0.229	0.635
Error Between	3145.198	39	80.646		
Within Subjects					
Times (T)	544.239	2	272.120	29.242	0.000**
Linear	523.925	1	523.925	44.239	0.000**
Quadratic	20.314	1	20.314	3.001	0.091
T*Gr	5.589	2	2.794	0.300	0.741
T*P	13.696	2	6.848	0.736	0.482
T*Gr*P	10.624	2	5.312	0.571	0.567
Error Within	725.859	78	9.306		

Note. *$p < .01$. **$p < .001$.

Data on lowest and highest pitches sung were analyzed to determine how the increase in total vocal range occurred. Results of a Repeated Measures Analysis of Variance (ANOVA) in Table 11 indicate a linear significant difference F (1, 78) = 6.224, $p < .05$ in the lowest pitch sung throughout the duration of the study. Tukey post hoc analysis (Appendix G, Table 20) revealed a significant difference from Treatment 1 to

Treatment 2 ($p < .01$). Analysis between groups revealed a significant difference by grade F (1, 39) = 9.395, $p < .01$, indicating that eighth graders sang lower than seventh graders (see Figure 5). Significant differences were also found between parts F (1, 39) = 27.990, $p < .001$, indicating that basses were able to sing significantly lower than tenors (see Figure 6). There were no significant interactions for lowest pitch sung with any other factors.

Table 11

Repeated Measures ANOVA with 2 Between-Subject Factors (Grade and Part) for Lowest Pitch Sung

Source	*SS*	*df*	*MS*	*F*	*p*
Between Subjects					
Grade (Gr)	213.736	1	213.736	9.395	.004**
Parts (P)	636.806	1	636.806	27.990	.000***
Gr*P	.242	1	.242	.011	.918
Error Between	887.292	39	22.751		
Within Subjects					
Times (T)	23.697	2	11.849	4.788	.011*
Linear	23.439	1	23.439	6.224	.017*
Quadratic	.258	1	.258	.218	.643
T*Gr	11.765	2	5.882	2.377	.100
T*P	1.687	2	.844	.341	.712
T*Gr*P	10.825	2	5.412	2.187	.119
Error Within	193.041	78	2.475		

Note. *$p < .05$. **$p < .01$. ***$p < .001$.

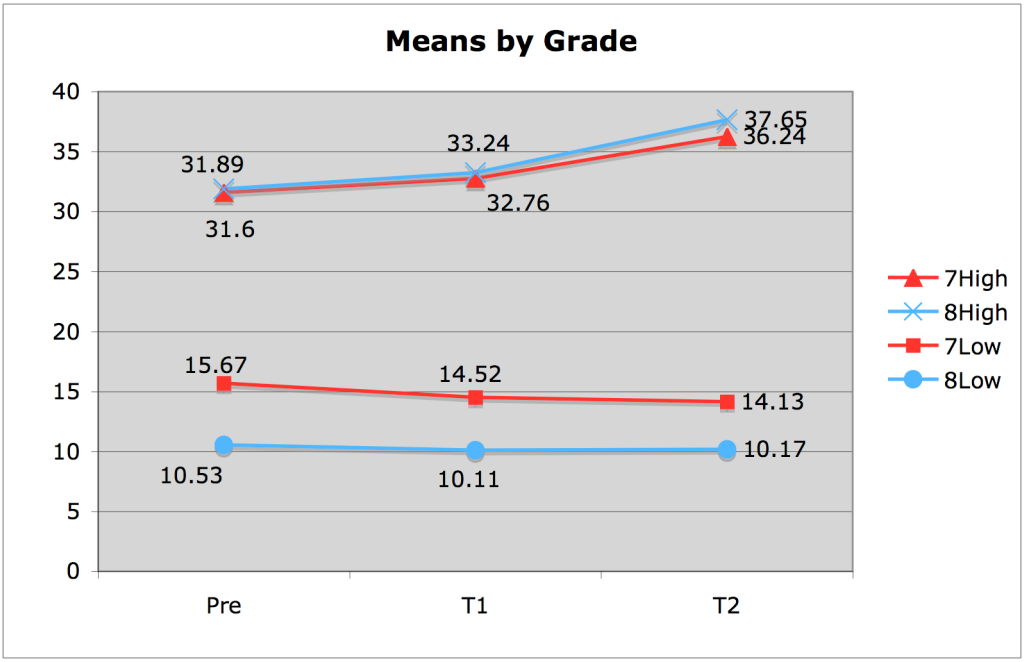


Figure 5. Means for highest and lowest pitch by grade level

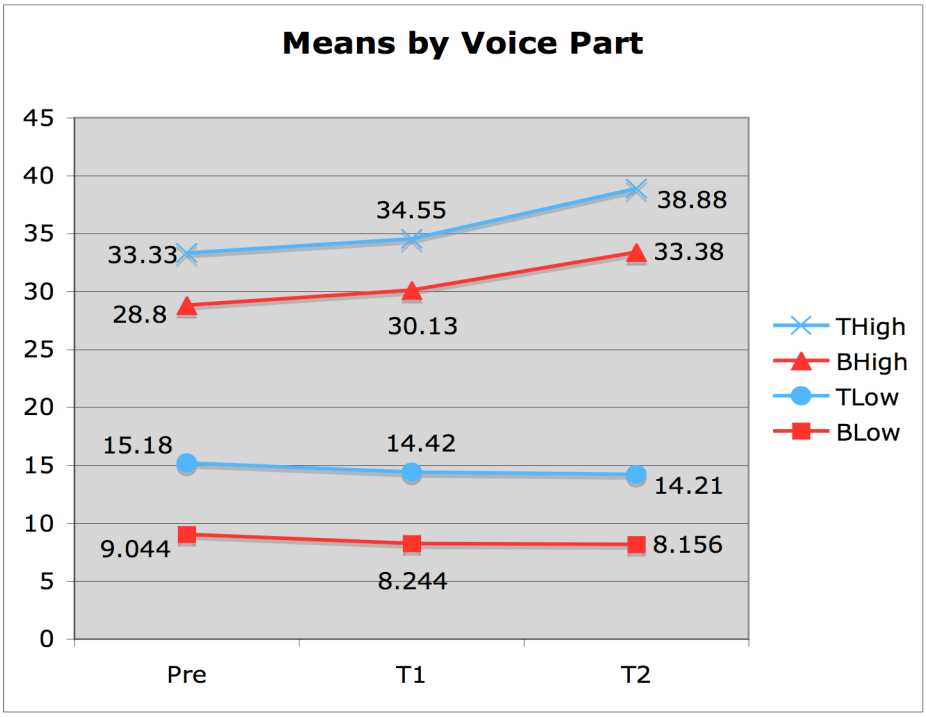


Figure 6. Means for highest and lowest pitch by voice part

Highest pitch sung was also analyzed with a Repeated Measures Analysis of Variance (ANOVA). Results in Table 12 revealed a significant difference in highest pitch sung over the three testing periods F (2, 78) = 26.184, $p < .001$. Moreover, this was a quadratic significant difference F (1, 78) = 5.598, $p < .05$, indicating a curve in the data as observed in Figure 6. The visual and statistical curve (see Figure 7) suggests a significantly greater increase in range for the entire sample ($N = 43$). Tukey post hoc analysis (Appendix G, Table 19) revealed a significant difference between the highest pitches sung from Treatment 1 to Treatment 2 ($p < .01$). Although no significant differences were found between grades, significant differences occurred between parts F (1, 39) = 13.827, $p < .001$. Specifically, tenors were able to sing significantly higher than basses (see Figure 6). There were no significant interactions for highest pitch sung with any other factors.

Table 12

Repeated Measures ANOVA with 2 Between-Subject Factors (Grade and Part) for Highest Pitch Sung

Source	*SS*	*df*	*MS*	*F*	*p*
Between Subjects					
Grade (Gr)	189.101	1	189.101	3.112	.086
Parts (P)	840.103	1	840.103	13.827	.001**
Gr*P	14.497	1	14.497	.239	.628
Error Between	2369.570	39	60.758		
Within Subjects					
Times (T)	350.848	2	175.424	26.184	.000***
Linear	325.715	1	325.715	36.555	.000***
Quadratic	25.133	1	25.133	5.598	.023*
T*Gr	31.556	2	15.778	2.355	.102
T*P	24.634	2	12.317	1.838	.166
T*Gr*P	29.015	2	14.508	2.165	.122
Error Within	522.580	78	6.700		

Note. *$p < .05$. **$p < .01$. ***$p < .001$.

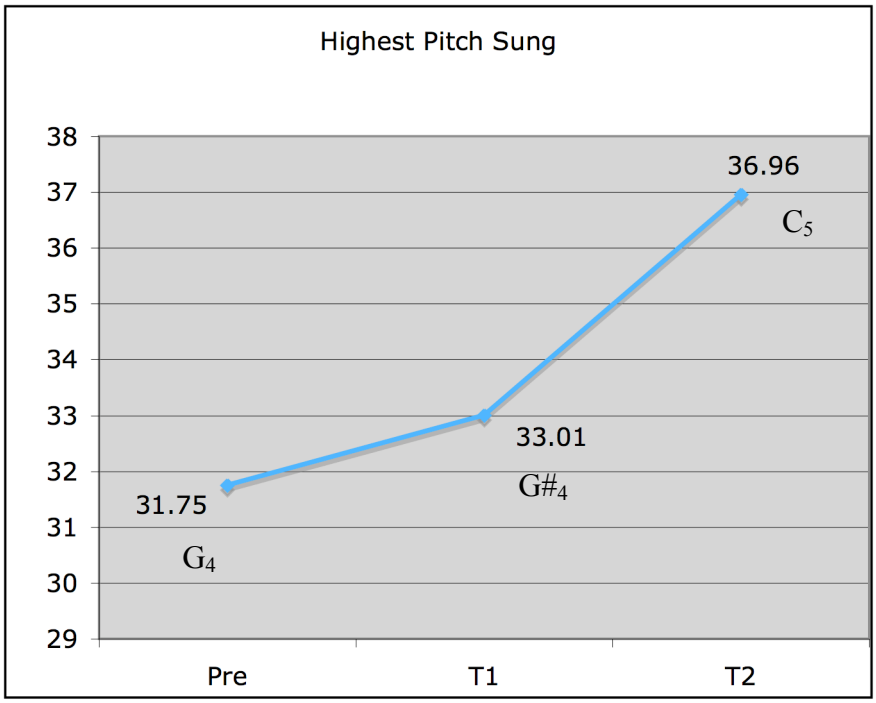


Figure 7. Significant quadratic increase in highest pitch sung

Research question two. The second research question sought to determine if vocal registration training would account for any significant differences in the subjects' perception of vocal comfort while singing 3-part and SATB arrangements. The subjects rated their perceived vocal comfort after Treatment 1 (3-part mixed arrangements) and Treatment 2 (SATB arrangements) on a five-point semantic differential scale. The appropriate correlation statistic was Spearman rank order correlation because the specific measurement between the poles (very uncomfortable and very comfortable) was ordinal.

The Spearman rank order correlation results in Table 13 indicate a significant correlation ($p < .01$) between the ratings of each treatment period for all three songs. Specifically, a high vocal comfort rating in Treatment 1 (3-part) was associated with a similar rating in Treatment 2 (SATB). Moreover, low vocal

comfort ratings in Treatment 1 were associated with low ratings in Treatment 2. These results suggested that no significant differences were found between the two treatment periods on a measure of perceived vocal comfort. The mean score for all vocal comfort ratings was 3.77, suggesting that subjects were able to sing with general comfort during each song.

Table 13

Spearman rank order correlation Results for Vocal Comfort Ratings

Song	*R*	*p*
Jubilant Gloria	.592	.000*
Inscription of Hope	.595	.000*
I am the River	.521	.000*

Note. *$p < .01$

Research question three. The third research question asked if significant differences existed in the subjects' preferences toward 3-part mixed and SATB arrangements. Data was collected through an anonymous survey at the conclusion of the study. Specifically, the subjects stated their preferences toward the 3-part and SATB arrangements learned. The entire sample of recruited subjects participated in the survey ($N = 48$). Distribution of these subjects is found in Table 2 (Chapter 3).

Survey responses in Table 15 indicated that 17% of the subjects ($n = 8$) preferred 3-part mixed arrangements, compared to 83% ($n = 40$) who preferred SATB. Frequency data was analyzed with a *z*-test of proportions and revealed a significant preference toward SATB music ($p < .001$). Additionally, 84% either

somewhat (n = 11) or strongly disagreed (n = 29) with the statement that SATB music is too difficult for middle school choirs.

A Chi-Square test was performed to examine differences between grades (seventh and eighth) and parts (tenor and bass). Results in Table 14 indicated that no significant differences occurred between groups.

Table 14

Chi-Square Results for Preferences Toward 3-Part and SATB Arrangements

Factor	χ^2	*df*	*P*
Parts			
Pearson Chi-Square	.85	1	.36
Grade			
Pearson Chi-Square	.82	1	.37

Table 15

Subject Responses to Survey Questions

Question	$N = 48$	
	N	%
After learning the songs in this study, which type do you prefer?		
3-part	8	17%
SATB	40	83%
SATB choir music with tenor and bass parts is too difficult for middle school choirs.		
Strongly disagree	29	61%
Somewhat disagree	11	23%
Somewhat agree	2	4%
Strongly agree	2	4%
I don't know	4	8%

The need for direct feedback from students was discussed in Chapter One. To address this need, each subject responded to descriptive survey questions about his preferences toward 3-part and SATB music. Those who preferred 3-part arrangements generally cited a comfortable vocal range as the leading factor, as illustrated in Table 16. Similarly, 62% ($n = 5$) of these same subjects disliked the SATB music because the notes were uncomfortable to sing.

Table 16

Subjects Who Preferred 3-Part Arrangements

Question	*N* = 8	
	N	%
What do you like most about the 3-part pieces?		
Baritone part is in comfortable range	5	62%
Enjoy strength in numbers on one part	1	13%
Other	2	25%
What do you like least about the SATB pieces?		
Notes are uncomfortable to sing	5	62%
Tenor/Bass split is too difficult to learn	1	13%
Other	2	25%

The subjects who preferred SATB arrangements cited a wider range of factors to determine their choice (see Table 17). Although 60% (*n* = 24) chose vocal comfort as the leading factor, ensemble sound emerged as a motive among 25% (*n* = 10). The challenge of singing SATB music was also cited by 5% of the subjects (*n* = 2). Yet 40% (*n* = 16) disliked 3-part arrangements because the single baritone part was boring and unchallenging. An additional 18% (*n* = 7) disliked 3-part music because the ensemble sounded better when split into tenor and bass parts.

Table 17

Subjects Who Preferred SATB Arrangements

Question	$N = 40$	
	N	%
What do you like most about the SATB pieces?		
Parts are comfortable to sing	24	60%
Sound is better when split into TB parts	10	25%
It is challenging to sing SATB music	2	5%
Other	4	10%
What do you like least about the 3-part pieces?		
Baritone part is too high	13	32%
Sound is better when split into TB parts	7	18%
One baritone part is boring	16	40%
Other	4	10%

Chapter 5

Discussion

The present study investigated adolescent male vocal registers and repertoire selection for middle school choirs. Components of an experimental design by Emge (1996) were replicated to determine if singing in various vocal registers might extend the comfortable singing range of boys. The study sought to determine (a) the vocal range of subjects before and after vocal registration training, (b) the perceived comfort level of subjects before and after vocal registration training, and (c) the preferences of subjects towards 3-part mixed and SATB arrangements. Subjects ($N = 48$) were seventh ($n = 23$) and eighth grade ($n = 25$) boys enrolled in elective choirs at a single middle school.

Subjects were individually tested three times (Pretest, Treatment 1, and Treatment 2) throughout a 6-week period. The first 3 weeks (Treatment 1) included a pretest for vocal range followed by instruction of standard 3-part choir literature on the tenets of School A and a measurement of perceived vocal comfort. The subsequent 3 weeks (Treatment 2) included instruction in various vocal registers as a period of treatment, utilizing new warm-ups, vocalizes, and SATB choral literature based on the tenets of School B. Data were collected on the dependent variables of (a) lowest pitch sung, (b) highest pitch sung, (c) total range sung, and (d) perceived comfort level while singing 3-part and SATB arrangements. Additionally, attitudinal data was collected through the online anonymous survey found in Appendix F.

Vocal Range. Each subject sang descending 5-note patterns (scale degrees 5, 4, 3, 2, 1; syllables *sol, fa, mi, re, do*) on an "*ah"* vowel to determine the lowest pitch sung during three testing periods. Likewise, each sang an arpeggio (scale degrees 1, 3, 5, 3, 1;

syllables *do, mi, sol, mi, do*) on an "*ah*" vowel to determine the highest pitch sung. Data were analyzed using a Repeated Measures ANOVA, which revealed a significant increase in total range over the three testing times ($p < .001$). Specifically, a significant difference in lowest pitch sung ($p < .05$) was observed throughout the study duration. Results also revealed a significant difference in the highest pitch sung ($p < .001$).

These findings replicate those by Emge (1996) who determined that subjects were able to "significantly increase ($p < .01$) the highest pitch sung and significantly lower ($p < .001$) the lowest pitch sung, resulting in a significant increase ($p < .001$) in singing range throughout the duration of the study" (p. 74). Moreover, the findings of the present study replicate Phillips and Emge (1994) who found that "subjects averaged a higher and lower vocal pitch on the posttest and an overall increase in vocal range ($p < .001$) from pretest to posttest" (p. 14).

Middle school choral conductors may apply these findings to warm-up exercises and overall rehearsal planning. Choirs often perform identical warm-ups at the beginning of each rehearsal without knowing the purpose. Implications of this study indicate that a variety of purposeful exercises can increase vocal range. However, one may consider using a descending melodic pattern instead of an ascending arpeggio to test the highest pitch sung (see Appendix B). It is possible that young singers will have greater vocal success without carrying the weight of lower pitches into the higher range.

The present study sought to determine if a 3-week period of vocal registration training would account for changes in the total range that subjects were able to sing. The significant increase observed supports the research of Mayer and Sacher (1964) who taught boys to sing "a fifth lower in a day's time" (p. 9) through vocal registration

training. Implications involve a paradigm shift for those who teach 3-part and SAB music exclusively. Vocal exercises and SATB repertoire that explore a wider range may be introduced for teaching purposes without the intention of performance. Introductory lessons on vocal registers and SATB voicings may begin in the second semester when voices are more mature and spring concerts are accomplished. As is often the case, a new challenge may become the preferred method for the students and teacher, thus broadening performance possibilities.

The limited range of 3-part music and the research of School A is intriguing for choirs with small numbers of boys. Phillips (1996) believes that "cultivation of the lower voice, however, should not be omitted from voice study, as a properly produced lower adjustment (unforced) is basic to the speaking voice and proper phonation. It is the voice with which children are initially most comfortable" (p. 225). Although the lowest mean pitch sung in the present study did not decrease dramatically, (Pretest C_3: 13.04, Treatment 1 B_2: 12.26, Treatment 2 B_2: 12.10), the change was significant ($p < .05$).

However, more dramatic changes were identified for the highest pitch sung (Pretest G_4: 31.75, Treatment 1 $G\#_4$: 33.01, Treatment 2 C_5: 36.96) resulting in a quadratic significant difference over the three testing periods ($p < .05$). The concluding mean vocal range of the subjects in this study spanned 25 half-steps from B_2 to C_5. Cooksey (1999) found a range of 16 half-steps for seventh and eighth grade boys (see Chapter 2, Table 1). Similarly, Cooper and Kuersteiner (1965) described a range of 19 half-steps for the cambiata voice part (p. 15). Therefore, the present study suggests that the singing ranges of seventh and eighth grade males are greater than those proposed by the authors of School A.

The mean vocal range identified in the present study reflects the research of School B. After a 3-week period of training, the subjects were able to bridge the gap between upper and lower registers. Phillips (1996) discussed junior high basses who, "do change quickly and often exhibit a lower range, an upper range, and no middle" (p. 62). However, the subjects in this study were able to facilitate through an average range of B_2 to C_5 using the exercises in Appendix E.

One must discuss the extremes of the vocal ranges reported within the context of tessitura. Although the findings support the extended range theory of School B, results also indicate that seventh and eighth graders are able to sing the 3-part arrangements taught with general vocal comfort. These 3-part arrangements (see Chapter 3, Figure 3) typify a limited-range and tessitura from G_3 to D_4. However, Mayer and Sacher (1964) caution:

> One of the chief enemies of healthy vocal practice at any age is fatigue, and one of the greatest contributors to vocal fatigue is singing in a very narrow compass- even though that compass might appear to be a comfortable tessitura for the voice. (p. 12)

Vocal Comfort. The present study investigated perceived vocal comfort ratings of students while singing 3-part mixed and SATB choral arrangements. Emge (1996) examined vocal comfort during solo performances of *America* in various vocal registers. His study "was concerned with subjects' ability to sing comfortably in each register, thereby increasing vocal literature available to the junior high choir director to include four-part SATB mixed" (p. 82). Although choral music educators train individual singers, the majority of on-task time is focused on ensemble performances. Holtgreve (1962) questioned, "after all the theories have been expounded, voices categorized, and ranges standardized, you still have a chorus of boys whose ranges and abilities are different.

What are they going to sing?" (p. 16). The challenge is selecting music that appeals to the group and accounts for individual vocal differences. Fortunately, repertoire options have increased over the years as composers and arrangers have published individual songs in various voicings.

Few studies have investigated the significance of these voicings and how adolescent singers perceive them. Therefore, the present study examined the vocal comfort of subjects during performances of standard choral literature (see Chapter 3, Table 3). Subjects rated their perceived vocal comfort after Treatment 1 (3-part mixed arrangements) and Treatment 2 (SATB arrangements) on a 5-point semantic differential scale (see Appendix D). Spearman rank order correlation results indicated that no significant differences were found between the two treatment periods on a measure of perceived vocal comfort. Rather, a significant correlation ($p < .01$) was found between the perceived comfort levels of 3-part and SATB arrangements. The mean score for all vocal comfort ratings was 3.77 on the 5-point scale, suggesting that subjects perceived the performance of each song with a general sense of comfort. These findings are consistent with Emge (1996) who found that "in general, both judges and students rated singing in different registers as comfortable" (p. 85)

The significant correlation between comfort levels on 3-part mixed and SATB music may be due to the specific arrangements chosen. All three pieces have sustained unison sections for baritones (3-part), tenors, and basses (SATB). It is possible that the subjects' perceived comfort ratings were similar in each voicing because of these unison passages. Perhaps the results would be different if the Treatment 2 pieces had more

tenor/bass splits. However, the unison passages may have contributed to the positive responses toward SATB music on the attitudinal survey.

The present findings may benefit future research that investigates the effect of choral repertoire on perceived vocal comfort. Diverse repertoire and associated survey questions on vocal comfort may increase research validity. Replication of this study may consider several vocal ratings for each song, perhaps at the conclusion of strategic phrases. The additional ratings increase the amount of data for analysis and the likelihood for relevant conclusions.

Attitudinal Data. Each subject completed an online survey to investigate preferences and attitudes toward the 3-part mixed and SATB arrangements studied. Although Chi-Square results found no significant differences between grades (seventh and eighth) or parts (tenors and basses), frequency data revealed that 83% (n = 40) preferred the SATB arrangements in Treatment 2. While the SATB unison passages contributed to the significant correlation with 3-part mixed because of similarity, the tenor/bass splits throughout each piece may have provided occasional flexibility. Perhaps this flexibility led to a preference toward SATB music.

Similar results indicated that 84% of the subjects either somewhat disagreed (n = 11) or strongly disagreed (n =29) with the statement that SATB music is too difficult for middle school choirs. Unison passages may have also been a factor on these responses because the selections were not composed with split tenor/bass parts throughout. One may consider these results when selecting repertoire, as it appears that the subjects do not perceive the specific SATB arrangements as "difficult" if unison passages exist.

Finally, survey questions investigated possible factors that led to a preference toward the 3-part and SATB pieces studied. Only 17% (n = 8) of the subjects preferred the 3-part mixed arrangements. The comfortable range of Part III was the most important factor for 62% of these subjects (n = 5). Similarly, these same subjects cited an uncomfortable range as the reason for disliking the SATB arrangements. Two subjects provided interesting statements to explain their preferences toward 3-part music. One stated that a single Part III is "easier to read." Another believes that 3-part music is easier "because there aren't so many parts to listen to when you are singing."

Choir directors may also consider that 63% (n = 5) of the subjects who preferred the 3-part arrangements were in seventh grade. The limited range combined with a single part to read and hear may have been appealing to these younger singers. Implications of this finding may limit the inclusion of SATB voicings to eighth grade choirs and beyond. Readiness for reading four parts may be improved through explicit curricular articulation from elementary choral music through high school. The middle school choral director must therefore bridge the gap from unison/2-part octavo reading in elementary school to SATB and SSAATTBB mixed voicings in high school.

Responses were more varied for those who preferred the SATB arrangements studied. Vocal comfort was the most important factor for 83% (n =40) of these subjects. Similarly, 32% (n = 13) found discomfort during the 3-part mixed arrangements because "the baritone part was too high." As one would anticipate, the majority of the singers who disliked the high range were basses. Sound of the ensemble emerged as an important reason for 25% (n =10) of those who preferred SATB arrangements. Although only 5%

(n = 2) of the subjects enjoyed the challenge of singing SATB music, 40% (n = 16) disliked 3-part music because "one baritone part was boring."

Future Research. Several strategies for future research are suggested by the results of the present study. The purpose was to investigate adolescent male vocal registers and repertoire selection for middle school choirs. Although the methodology replicated components of Emge's study (1996), this study examined choral ensemble performances rather than the solo voice. A replication of this study with a larger sample is suggested to gather more data on vocal registration training in ensemble settings. Results may be more conclusive if the SATB arrangements taught have more tenor/bass splits and less unison passages. The limitations of the present study stated that the same subjects were being tested twice (Treatment 1 and Treatment 2). Therefore, it might also be of interest to implement an experimental design, teaching the 3-part mixed arrangements in a control group compared to SATB in the treatment.

Implications of this study suggest strategic repertoire selection for middle school choirs that divide the boys into more than one part. Among anticipated concerns are small numbers of boys, limited rehearsal time, and preparation for performances. The present study does not suggest a complete change to SATB repertoire at the middle school level. Rather, implications suggest careful inclusion of SATB music in addition to 3-part music. Introduction to new voicings may begin in the second semester as preparation for the upcoming school year. Although the present method studied mixed ensemble repertoire, future research may also include male chorus repertoire (TB, TTB, TTBB).

Further research is also needed to examine the best practices of teachers who have an influence on the success of middle school male singers. Qualitative research that

generates a rich description through case studies may be the best method to gather this data. The sample could include middle school choral directors who have earned consecutive superior ratings at festivals. Susan Monks' qualitative study (2003) supports the need for empirical and descriptive research on the adolescent voice. She believes that "it is only listening to singers in musical situations as performers or teachers that research can continue to have relevance in the real world of music education" (p. 255).

Summary. Middle school choir teachers should address the individual differences among adolescent male singers in an ensemble setting. The framework of the present study discussed the lack of practical strategies for ensemble instruction and repertoire selection as a salient problem. While theories about the individual voice change process have been well documented, more research was needed to address group strategies for middle school choral ensembles. Therefore, the purpose of this study was to investigate adolescent male vocal registers and repertoire selection for middle school choirs. The study sought to determine (a) the vocal range of subjects before and after vocal registration training, (b) the perceived comfort level of subjects before and after vocal registration training, and (c) the preferences of subjects towards 3-part mixed and SATB arrangements.

Results indicated that subjects were able to significantly increase their total vocal range over a 6-week period of time. Specifically, subjects significantly decreased the lowest pitch sung and increased the highest pitch sung. No significant differences were found between the two treatment periods on a measure of perceived vocal comfort. The means reported in Chapter 4 suggest that subjects were able to sing with general vocal comfort during 3-part mixed and SATB performances. However, frequency data

indicated that 83% of the subjects preferred SATB arrangements over 3-part mixed. There were no significant differences between grades or vocal parts.

Results of the present study suggest that training in various vocal registers can significantly increase the vocal range of adolescent male singers. Although survey responses indicate perceived vocal comfort while singing 3-part and SATB music, the majority preferred the SATB arrangements studied. Nevertheless, one must consider the importance of singing during the adolescent years, specifically in choral ensembles. Phillips (1996) stated:

> A most important consideration is that adolescent students must be kept singing throughout the early adolescent years. The senior high school choral program relies heavily upon the feeder system of the junior high or middle school. Generally, once students drop out of vocal music in the seventh or eighth grades, they do not return to it. (p. 76)

The results of the present and future studies may be applied to choral music warm-ups, repertoire selection, and ensemble teaching strategies. Research suggests that boys should be actively singing during the challenging adolescent years. Findings of the present study therefore advocate the inclusion of choral music in the curriculum and master schedule, encouraging teachers to use researched, best practices to promote lifelong enjoyment and involvement in singing.

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Appendix A

Consent Letters

[redacted]

Dear Choir Parent,

I am completing a Doctorate in Music Education at Rutgers University. As part of my dissertation research study, I am interested in the attitudes of 7th and 8th grade male singers. **The study is based on the assumption that singing practice during middle school years improves and expands vocal range.** Individual vocal range will be also tested to determine if the boys are tenors or basses. Additionally, I am researching types of music that adolescent male choir students enjoy singing. Their opinions will then be surveyed regarding choir music learned at [redacted] Middle School. Your permission is being sought for your son to participate in the study, which I have received permission to conduct at [redacted] Middle School.

Participation is VOLUNTARY. You may chose for your child not to participate, and you may withdraw your child from participating at any time during the study activities without any penalty to your child. In addition, your child may choose not to answer any questions with which he is not comfortable. Your child will also be asked if they wish to participate in this study.

The evaluation procedures will involve meeting with the students individually before and and/or after school on a VOLUNTARY basis. Each student may volunteer to attend three or four brief meetings (TBA) in May and June. Many times and dates will be posted to eliminate schedule conflicts. Their vocal range will be charted and a survey will be completed. Vocal testing will be audio recorded, requiring additional permission signatures on the attached Audio Addendum Form.
Note:

1. Your child will not be required to sing in front of anyone (other than the investigator)
2. Participation in the study will not affect your child's grade
3. Participation in the study will not affect your child's class work
4. Your child's name will not appear in the dissertation

Confidentiality will be assured throughout the process. The results of this study will certainly improve the [redacted] choir program and provide valuable insight to other teachers. The purpose and procedures of the study have been reviewed and approved by Rutgers University personnel and (insert school name) school administration. I would be happy to answer any questions you might have. Thank you for your consideration.

Sincerely,

Stacey Sassi
Choir Director

Parent/Guardian Consent Form

Your child is invited to participate in a research study concerning the effects of vocal training on the adolescent male singing voice. Male participation in choral music has been a problem for many music educators because of adolescent voice changing and peer relationships. Therefore only males will be studied. There will be 60 VOLUNTARY participants in study, all of which are students enrolled in two curricular choral ensembles. Your child's participation in this study will occur during brief meetings before and/or after school over an 8-week period. There will be a pretest to determine your child's vocal range, vocal exercise instruction, a posttest to determine possible changes, and a concluding survey. Vocal testing will be audio recorded, requiring additional permission signatures on the attached Audio Addendum Form.

This research is anonymous, which means no information will be recorded about you/your child that could identify you/your child. You/your child's name, address, phone number, and date of birth will not be recorded. If you/your child agree to take part in the study, your child will be assigned a random code number that will be used on each test and the questionnaire. Your child's name will appear only on a list of subjects and will not be linked to the code number that is assigned to your child. There will be no way to link your child's responses back to your child. Therefore, data collection is anonymous.

There are no foreseeable risks associated with your child's participation in this research project. Your child's participation in this study will assist in determining the effectiveness of vocal training on the singing range of choral musicians.

Your child's participation is voluntary. You and your child have the right to withdraw your consent or discontinue participation at any time without penalty. You will receive a copy of this consent form for your records and group results will be shared at the conclusion of the study.

If you/your child have any questions about the study or study procedures, you/your child may contact me:

Stacey Sassi
[redacted]

or you may contact my faculty advisor at:

Dr. Rhonda S. Hackworth
rshackwo@rci.rutgers.edu
732-932-1955
Rutgers University, Maryott Music Building
81 George St.
New Brunswick, NJ 08901

If you/your child have any questions about your rights as a research subject, you may contact the Institutional Review Board (a committee that reviews research studies in order to protect those who participate). Please contact the IRB Administrator at:

Rutgers University, the State University of New Jersey
Institutional Review Board for the Protection of Human Subjects
Office of Research and Sponsored Programs
3 Rutgers Plaza
New Brunswick, NJ 08901-8559
Tel: 732-932-0150 ext. 2104
Email: humansubjects@orsp.rutgers.edu

I understand the information presented above. My signature below shall serve as my consent to participate in this project.

Name of Student (printed)	Date
Signature of Parent/Guardian	Date
Signature of Principal Investigator	Date

ASSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

Investigator: Stacey Sassi, Rutgers University
Project Title: Effects of Vocal Registration Training on the Vocal Range and Perceived Comfort of the Adolescent Male Singer

This assent form may contain words that you do not understand. Please ask Mrs. Sassi (the researcher) or your parent to explain any words or information that you do not clearly understand before signing this document.

1. **Mrs. Sassi is inviting you to take part in his/her research study.**
   Why is this study being done?
   Mrs. Sassi is completing a Doctorate in Music Education.
   She wants to investigate types of music and warm-ups that work best for middle school male singers.

2. **What will happen?**
   First, you will have your vocal range tested individually. You will NEVER have to sing individually in front of your peers. Voice testing will be audio recorded for analyze highest and lowest pitches sung. You will then learn 3 songs with a baritone part. Next, you will learn the same songs with tenor and bass parts, in addition to new vocal warm-up exercises. Then, your range will be tested individually to determine if changes were made from the first test. Finally, a 25-question survey will be handed out to receive feedback from you regarding the procedures explained.

3. **What does it cost and how much does it pay?**
   You do not pay to take part in this study, and your participation is voluntary.

4. **There are very few risks in taking part in this research, but the following things could happen**:
   Probably: Nothing bad would happen.
   Maybe: For example: somebody not involved in this study would see your surveys and pretests/posttests. I will do my absolute best to keep all your answers private. Your answers will be locked away. Your name will not appear on the answer sheets; we will use a code number instead.
   Very unusual: You could be upset by your performance in the vocal range testing. If this should occur, remember that your identity is kept anonymous in the reporting of results.

5. **Are there any benefits that you or others will get out of being in this study?**
   All research must have some potential benefit either directly to those that take part in it or potentially to others through the knowledge gained. The only direct benefit to you may be the enjoyment of training to become better singers. The knowledge gained through this study may allow me (and other music educators) to develop more effective training programs to improve singing ability. **It's completely up to you!** Both you and your

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

6. **CONFIDENTIALITY: I will do everything I can to protect the confidentiality of your records.** If I write professional articles about this research, they will never say your name or anything that could give away who you are. I will do a good job at keeping my entire records secret by following the rules made for researchers.

7. **Do you have any questions?** If you have any questions or worries regarding this study, or if any problems come up, you may contact me at:

You may also ask questions or talk about any worries to the Institutional Review Board (a committee that reviews research studies in order to protect those who participate). Please contact the IRB Administrator at Rutgers University at:

Rutgers University, the State University of New Jersey
Institutional Review Board for the Protection of Human Subjects
Office of Research and Sponsored Programs
3 Rutgers Plaza
New Brunswick, NJ 08901-8559
Tel: 732-932-0150 ext. 2104
Email: humansubjects@orsp.rutgers.edu

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

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

Name of Student (please print)	Date
Signature of Student	Date
Signature of Principal Investigator	Date

AUDIO ADDENDUM TO CONSENT FORM

You and your child have already agreed to participate in a research study entitled: **Effects of Vocal Registration Training on the Vocal Range and Perceived Comfort of the Adolescent Male Singer** conducted by **Stacey Sassi.** I am asking for you and your child's permission to allow me to **audio** tape your voice as part of that research study.

The recording(s) will be used for data analysis. Each recorded example will be used to analyze highest and lowest pitches sung.

The recording(s) will **NOT** include you/your child's name; you/your child will therefore remain anonymous to anyone who listens to the tape. A random subject ID number will be used to introduce each singer. Selected vocal exercises will be recorded to analyze highest and lowest pitches sung.

The recording(s) will be stored in a locked cabinet drawer with no identification link to you or your child.

Your signature on this form grants the investigator named above permission to record you as described above during participation in the above-referenced study. The investigator will not use the recording(s) for any other reason than that/those stated in the consent form without your written permission.

Student (Print) _____

Student Signature _____ Date _____

Parent Signature _____ Date _____

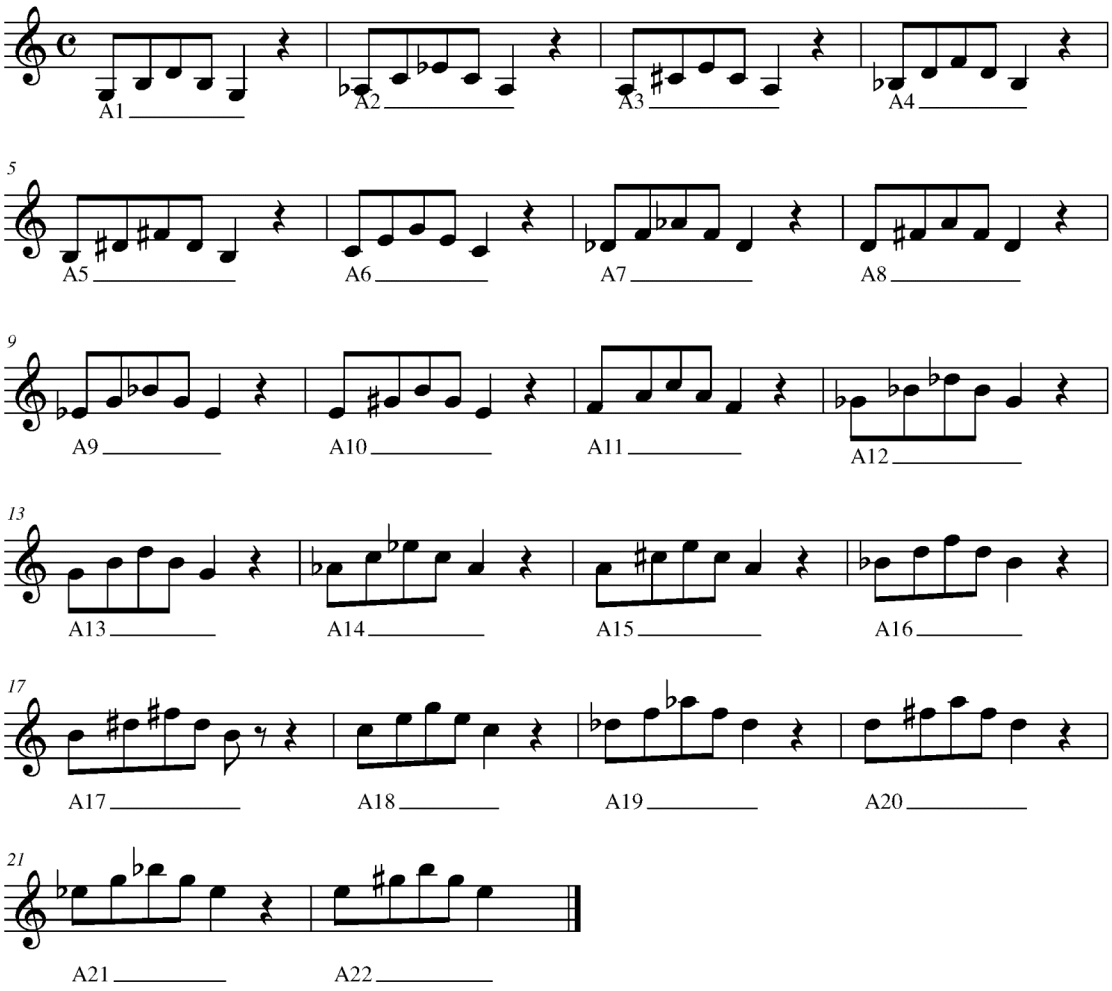
Principal Investigator Signature _____ Date _____

Appendix B

Range Testing Instructions

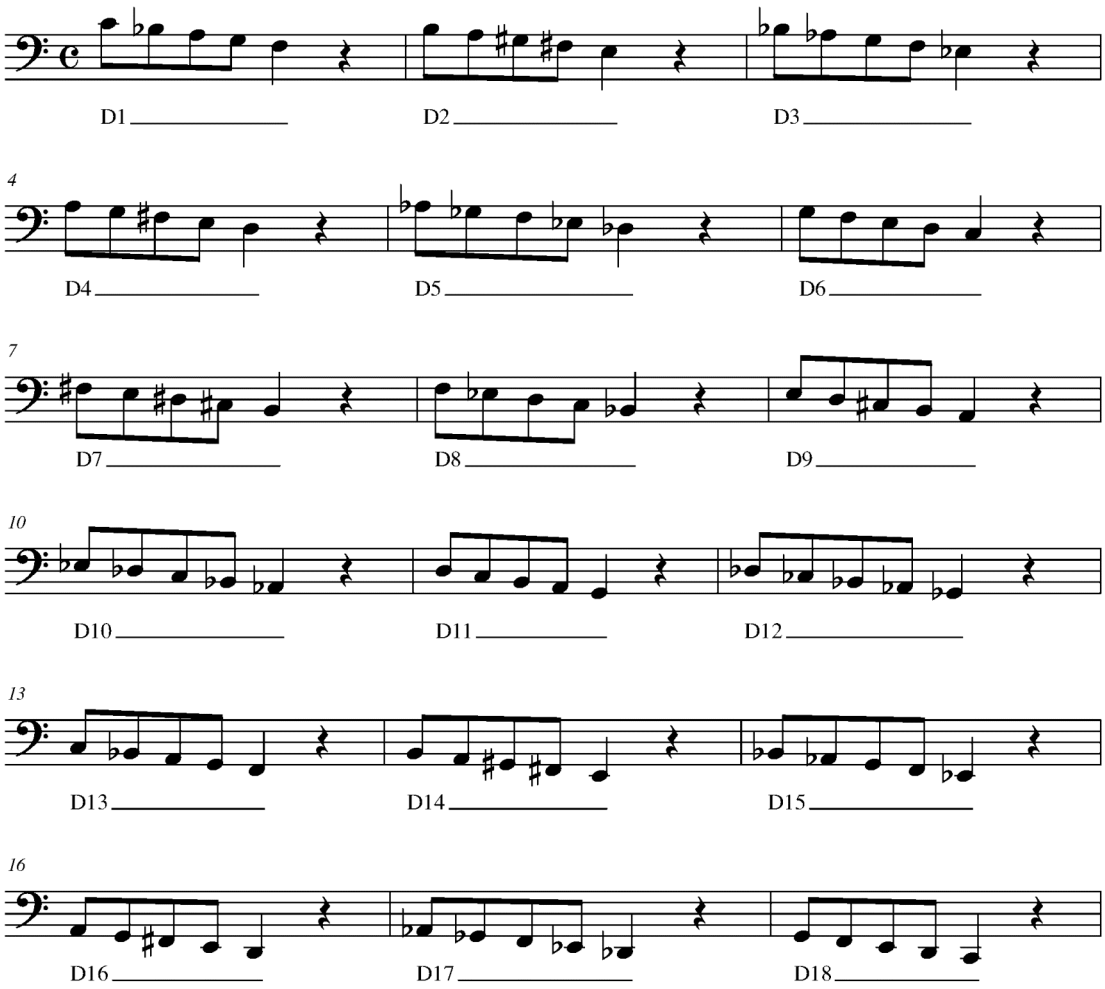
Ascending Patterns for Highest Pitch Sung

Instructions for judges*: You will hear each student sing the ascending patterns below on an "ah" vowel. The pattern number will be called before each example is sung (A1, A2, etc). Please follow the music while the students sing. Circle the highest pitch you believe was sung on the VOCAL RANGE DATA SHEET.*



Descending Patterns for Lowest Pitch Sung

Instructions for judges*: You will hear each student sing the descending patterns below on an "ah" vowel. The pattern number will be called before each example is sung (D1, D2, etc). Please follow the music while the students sing. Circle the lowest pitch you believe was sung on the VOCAL RANGE DATA SHEET.*

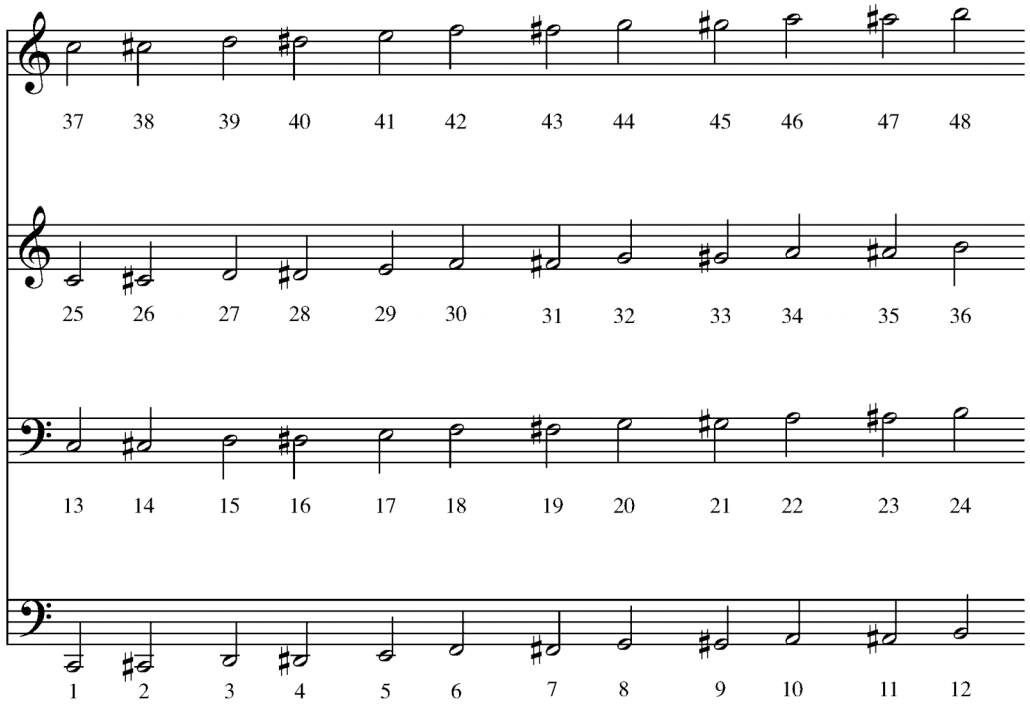


Appendix C

Vocal Range Chart

SUBJECT ID _____

VOCAL RANGE DATA SHEET



_____ Low pitch not discernible

_____ High pitch not discernible

Appendix D

Comfort Level Chart

Comfort Level Chart
Treatment 1 Phase

Subject ID # _____

Place an X on a line to indicate your level of comfort while singing each song. A mark in the center indicates a neutral feeling of vocal comfort. A mark on the left indicates more effort and greater discomfort while singing. Therefore, a mark on the right indicates less effort and more comfort while singing.

A Jubilant Gloria **(Lightfoot)**

_____ _____ _____ _____ _____
1 2 3 4 5
Very Uncomfortable — Very Comfortable

Inscription of Hope **(Stroope)**

_____ _____ _____ _____ _____
1 2 3 4 5
Very Uncomfortable — Very Comfortable

I am the River **(Bernon)**

_____ _____ _____ _____ _____
1 2 3 4 5
Very Uncomfortable — Very Comfortable

Comfort Level Chart
Treatment 2 Phase

Subject ID # _____

Place an X on a line to indicate your level of comfort while singing each song. A mark in the center indicates a neutral feeling of vocal comfort. A mark on the left indicates more effort and greater discomfort while singing. Therefore, a mark on the right indicates less effort and more comfort while singing.

A Jubilant Gloria **(Lightfoot)**

_____	_____	_____	_____	_____
1	2	3	4	5
Very Uncomfortable				Very Comfortable

Inscription of Hope **(Stroope)**

_____	_____	_____	_____	_____
1	2	3	4	5
Very Uncomfortable				Very Comfortable

I am the River **(Bernon)**

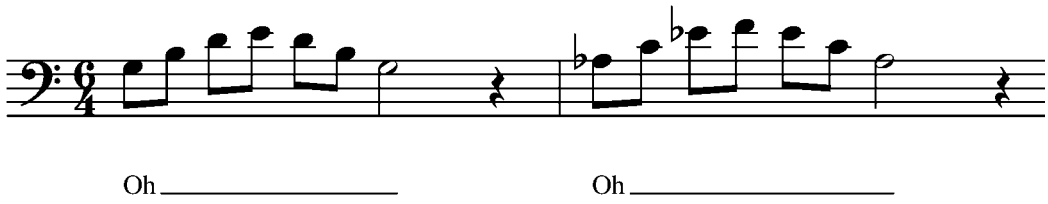
_____	_____	_____	_____	_____
1	2	3	4	5
Very Uncomfortable				Very Comfortable

Appendix E

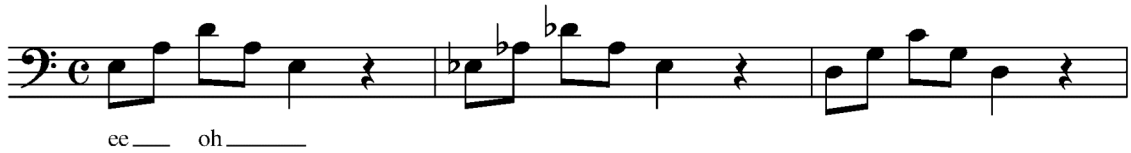
Treatment 2 Exercises

Treatment 2 Warm-ups

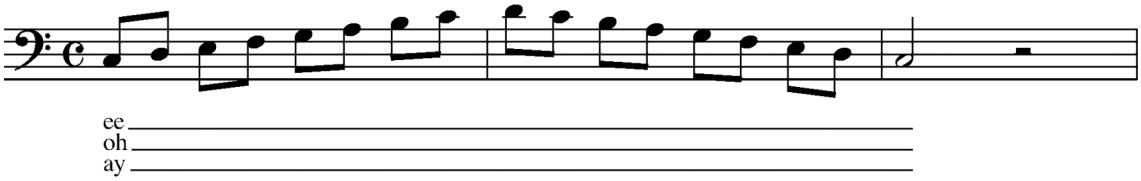
I. Third Plus One Exercise



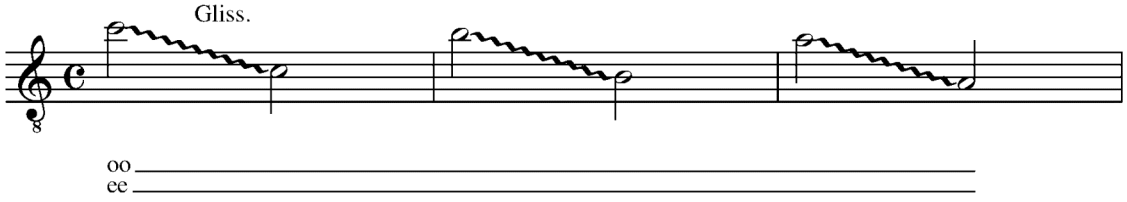
II. Fourths (“leap frog” through transition points)



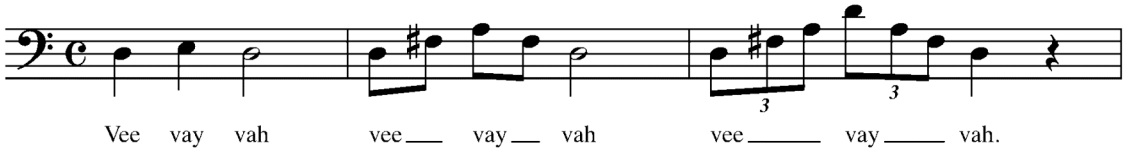
III. Nine-note Scale



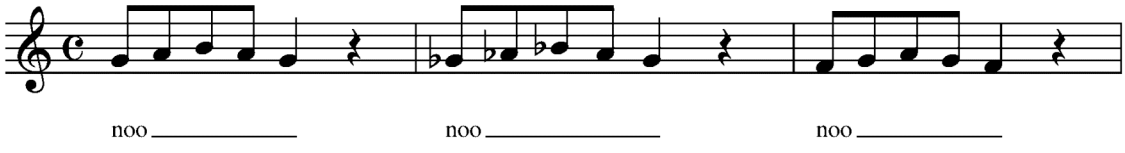
IV. Glissando (Falsetto to Mixed or Chest)



V. Triplet Pattern



VI. Head Voice



Appendix F

Participant Survey

1. Do you play a band or strings instrument in school?

    A. YES

    B. NO

2. Did you sing in your elementary school choir?

    A. YES

    B. NO

3. What was your voice part in this study?

    A. TENOR

    B. BASS

4. What is your age?

5. What grade are you in?

    A. 7^{th}

    B. 8^{th}

6. Are you embarrassed to sing in front of other people?

    A. NOT AT ALL

    B. RARELY

    C. SOMETIMES

    D. OFTEN

    E. VERY OFTEN

7. Which statement BEST describes the reason you are embarrassed to sing in front of other people?

    A. I AM SHY

    B. MY VOICE IS CHANGING

    C. MY VOICE HAS CHANGED

    D. I HAVE A BAD VOICE

    E. IT'S NOT COOL TO SING

8. "Participation in this study has improved my singing voice"

    A. I STRONGLY DISAGREE

    B. I SOMEWHAT DISAGREE

    C. I SOMEWHAT AGREE

    D. I STRONGLY AGREE

9. "Choir music with tenor and bass parts is too difficult for middle school choirs"

    A. I STRONGLY DISAGREE

    B. I SOMEWHAT DISAGREE

    C. I SOMEWHAT AGREE

    D. I STRONGLY AGREE

    E. I DON'T KNOW

10. After learning the songs in this study, which type do you prefer?

    A. 3-PART (With one baritone part)

    B. 4-PART (with tenor and bass parts)

11. What do you like MOST about the 3-part pieces in this study?

    A. THE BARITONE PART IS IN A COMFORTABLE RANGE

    B. THE BOYS SOUND BETTER ON ONE PART

    C. ONE BARITONE PART IS EASIER TO LEARN AND SING

    D. I ENJOY THE STRENGTH IN NUMBERS (ALL SING TOGETHER)

    E. OTHER

12. What do you like MOST about the 4-part pieces in this study?

    A. THE NOTES ARE MORE COMFORTABLE TO SING

    B. THE BOYS SOUND BETTER WHEN SPLIT INTO TWO PARTS

    C. IT IS CHALLENGING TO SING SATB MUSIC

    D. OTHER

13. What do you like LEAST about the 3-part music in this study?

    A. THE BARITONE PART IS TOO HIGH

    B. THE BOYS SOUND BETTER WHEN SPLIT INTO TWO PARTS

    C. IT IS BORING TO HAVE THE BOYS SING ONE PART

    D. OTHER

14. What do you like LEAST about the 4-part music in this study?

    A. THE NOTES ARE UNCOMFORTABLE TO SING

    B. THE BOYS SOUND BETTER ON ONE BARITONE PART

    C. THE TENOR/BASS SPLIT IS TOO DIFFICULT TO LEARN

    D. THE TENOR/BASS SECTIONS ARE TOO SMALL AND DON'T HAVE ENOUGH SINGERS

    E. OTHER

Appendix G

Post Hoc Analyses

Table 18

Tukey Comparison Test for Total Range Sung- Entire Sample

Means	Treatment 1 20.74	Treatment 2 24.86	$Q_{.01}$	$Q_{.05}$
Pretest- 18.71	2.03**	6.15**	1.99	1.58
Treatment 1- 20.74		4.12**	1.99	1.58

Note. $^{**}p < .01$.

Table 19

Tukey Comparison Test for Highest Pitch Sung- Entire Sample

Means	Treatment 1 33.01	Treatment 2 36.96	$Q_{.01}$	$Q_{.05}$
Pretest- 31.75	1.26	5.21**	1.69	1.34
Treatment 1- 33.01		3.95**	1.69	1.34

Note. $^{**}p < .01$.

Table 20

Tukey Comparison Test for Lowest Pitch Sung- Entire Sample

Means	Treatment 1 12.26	Treatment 2 12.10	$Q_{.01}$	$Q_{.05}$
Pretest- 13.04	-0.78	-0.94*	1.03	0.81
Treatment 1- 12.26		-0.16	1.03	0.81

Note. $^{*}p < .05$.

Appendix H

Raw Data by Subject

PRETEST VOCAL RANGE DATA

ID	Pre High Judge 1	Pre High Judge 2	Pre High Judge 3	Pre Low Judge 1	Pre Low Judge 2	Pre Low Judge 3
1	29	29	29	6	5	7
2	44	44	44	8	8	11
3	32	32	32	12	13	13
4	31	31	31	9	7	8
5	41	42	40	8	9	10
6	28	28	27	6	7	7
8	31	32	32	14	14	14
9	31	31	31	8	8	8
10	34	35	34	8	7	8
11	31	31	30	8	8	8
12	34	33	33	18	18	18
13	31	31	31	20	21	21
14	45	47	44	18	18	18
15	37	37	37	15	15	15
16	39	40	40	22	22	23
17	25	23	23	13	17	12
18	30	30	30	14	13	14
19	31	31	31	16	17	17
20	28	29	28	10	10	10
21	24	25	25	12	12	11
22	31	31	31	16	16	17
23	32	34	34	17	17	17
24	32	33	31	15	15	15
26	29	29	29	14	14	14
27	35	35	34	8	7	8
28	34	34	34	12	12	12
29	27	26	27	14	14	14
30	30	30	29	17	17	18
31	29	29	31	17	16	18
33	29	28	29	10	10	9
35	33	34	33	9	10	10
36	29	29	28	11	9	8
37	30	29	30	14	13	13
40	32	32	32	17	17	18
41	40	40	40	11	11	11
42	30	30	31	20	20	20
43	24	24	24	8	7	7
44	27	27	27	13	13	13
45	25	25	25	11	11	11
46	37	37	37	14	15	15
47	35	34	35	20	20	21
49	23	23	23	7	7	7
50	36	36	35	17	18	18

TREATMENT 1 VOCAL RANGE DATA

ID	T1 High Judge 1	T1 High Judge 2	T1 High Judge 3	T1 Low Judge 1	T1 Low Judge 2	T1 Low Judge 3
1	32	32	32	5	5	6
2	43	43	42	8	7	8
3	31	31	31	12	12	13
4	32	31	32	7	8	8
5	42	43	42	12	12	12
6	30	30	30	5	5	5
8	30	30	30	15	14	14
9	32	31	31	8	8	8
10	46	46	46	6	6	6
11	31	32	32	7	7	7
12	31	31	31	18	18	19
13	34	34	34	20	21	21
14	42	42	42	18	18	18
15	42	42	41	16	15	15
16	42	42	41	21	20	21
17	31	31	30	11	11	10
18	31	31	31	13	13	12
19	31	31	31	11	11	11
20	30	30	30	8	8	8
21	27	27	27	8	8	8
22	36	36	36	15	15	15
23	34	34	34	14	14	14
24	32	31	31	13	12	13
26	29	NA	29	12	12	12
27	35	35	35	6	6	6
28	34	34	34	12	13	13
29	28	NA	28	13	13	13
30	33	35	33	18	16	15
31	29	30	29	17	17	17
33	31	31	32	8	9	9
35	33	33	33	10	10	9
36	31	31	31	13	13	14
37	31	30	31	14	14	14
40	33	33	33	17	17	17
41	40	40	40	9	9	9
42	28	28	28	17	17	17
43	29	29	29	7	7	7
44	27	27	28	13	13	13
45	25	25	25	11	11	11
46	39	38	38	14	14	15
47	34	34	34	23	20	21
49	24	23	24	7	6	7
50	36	36	36	18	18	18

TREATMENT 2 VOCAL RANGE DATA

ID	T2 High Judge 1	T2 High Judge 2	T2 High Judge 3	T2 Low Judge 1	T2 Low Judge 2	T2 Low Judge 3
1	43	44	43	6	6	6
2	47	47	46	11	11	11
3	42	42	40	12	12	12
4	35	36	35	9	8	9
5	42	42	42	13	13	13
6	35	35	35	7	7	7
8	45	45	45	14	13	13
9	40	40	40	10	10	10
10	48	48	48	12	10	10
11	34	34	34	5	5	6
12	35	35	35	20	18	20
13	30	30	30	21	20	20
14	47	47	47	19	19	19
15	45	46	46	14	14	14
16	45	45	44	23	22	22
17	36	36	35	12	12	12
18	34	34	34	12	11	11
19	32	32	32	10	10	10
20	42	42	40	6	6	6
21	27	27	26	8	8	8
22	41	41	41	15	14	15
23	37	37	37	12	11	11
24	37	37	37	13	13	13
26	34	34	34	13	13	13
27	40	40	40	5	5	7
28	34	34	34	10	10	10
29	29	29	29	12	11	12
30	36	36	36	16	15	16
31	36	36	36	16	15	17
33	33	33	34	8	8	8
35	33	33	33	13	13	13
36	41	41	39	13	12	13
37	32	32	33	8	8	8
40	43	43	43	18	17	18
41	45	46	45	10	10	10
42	32	31	32	11	11	11
43	29	28	28	7	7	7
44	27	28	27	9	8	8
45	26	26	26	10	10	10
46	39	39	39	17	17	17
47	42	42	42	20	20	20
49	23	23	23	10	8	10
50	38	38	38	18	18	18

VOCAL COMFORT DATA

ID	Grade	Part	Gloria T1	Inscription T1	River T1	Gloria T2	Inscription T2	River T2
1	8	Bass	5	4	5	5	5	5
2	8	Tenor	5	4	5	5	5	5
3	8	Tenor	5	4	5	5	4	5
4	8	Bass	4	4	5	5	5	4
5	8	Tenor	5	5	5	5	5	5
6	8	Bass	5	4	4	4	4	5
8	7	Tenor	3	2	4	3	1	2
9	8	Bass	4	3	2	4	4	4
10	8	Tenor	5	5	5	5	5	5
11	8	Bass	4	3	5	5	5	5
12	7	Tenor	2	4	4	4	3	5
13	7	Tenor	5	4	4	4	2	3
14	7	Tenor	3	4	3	4	3	4
15	7	Tenor	4	3	1	4	2	4
16	7	Tenor	3	5	3	2	5	3
17	7	Tenor	5	4	5	5	4	5
18	8	Tenor	2	3	3	3	2	4
19	7	Tenor	5	5	5	5	5	5
20	8	Bass	4	3	4	5	4	4
21	7	Bass	4	2	4	2	3	4
22	7	Tenor	2	2	4	2	2	3
23	7	Tenor	5	4	4	4	5	5
24	7	Tenor	1	2	2	3	1	2
26	7	Tenor	2	3	3	4	4	3
27	8	Bass	4	4	5	5	4	5
28	7	Bass	4	4	4	5	4	4
29	7	Tenor	4	5	5	3	4	5
30	7	Tenor	2	4	3	4	2	5
31	7	Tenor	4	4	5	5	5	5
33	8	Bass	5	4	5	5	5	5
35	8	Bass	4	3	4	3	4	3
36	8	Tenor	5	5	5	5	5	5
37	8	Tenor	4	5	4	2	2	3
40	7	Tenor	3	3	3	4	3	5
41	8	Tenor	4	4	4	4	5	5
42	8	Tenor	4	4	5	5	4	5
43	8	Bass	2	2	2	1	3	5
44	7	Bass	3	2	3	4	3	4
45	7	Bass	2	2	2	2	2	2
46	7	Tenor	4	5	5	4	5	3
47	8	Tenor	3	3	3	3	3	3
49	8	Bass	3	3	3	5	4	4
50	8	Tenor	5	4	4	4	4	3

ANONYMOUS SURVEY DATA

Q 1	Q 2	Q 3	Q 4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
1	1	2	12	7	3	2	3	2	2	NA	1	4	NA
2	1	1	12	7	3	1	4	1	2	NA	1	4	NA
1	1	1	12	7	2	4	4	1	2	NA	2	3	NA
1	1	1	12	7	1	NA	3	1	2	NA	1	3	NA
2	2	1	12	7	2	2	4	1	2	NA	1	3	NA
1	1	2	12	7	3	1	4	2	2	NA	2	1	NA
1	1	1	12	7	3	1	4	1	2	NA	1	2	NA
1	1	1	13	7	3	1	4	1	1	5	NA	NA	5
1	1	1	13	7	3	1	3	2	1	5	NA	NA	1
1	1	1	13	7	3	4	2	1	1	1	NA	NA	1
1	1	1	13	7	2	1	4	1	1	1	NA	NA	1
1	2	1	13	7	3	1	4	1	1	4	NA	NA	3
1	2	1	13	7	1	NA	4	4	2	NA	1	4	NA
1	1	1	13	8	3	1	3	3	2	NA	2	3	NA
2	1	1	13	8	1	NA	3	2	2	NA	2	3	NA
1	1	1	13	8	4	4	4	1	2	NA	2	3	NA
2	1	1	13	7	2	2	4	1	2	NA	2	3	NA
1	1	1	13	8	4	4	3	NA	2	NA	2	3	NA
1	1	2	13	7	5	1	3	2	2	NA	1	3	NA
1	1	1	13	7	3	4	3	4	2	NA	1	3	NA
1	1	1	13	7	3	5	3	1	2	NA	4	1	NA
1	1	1	13	8	4	2	3	1	2	NA	4	1	NA
1	2	2	13	7	3	4	3	5	2	NA	1	1	NA
1	1	2	13	8	3	1	3	1	2	NA	1	1	NA
2	1	1	13	7	4	4	3	1	2	NA	1	1	NA
1	1	2	13	7	4	4	3	1	2	NA	1	1	NA
1	1	2	13	7	2	NA	4	1	2	NA	1	1	NA
1	1	2	13	8	2	1	3	1	2	NA	2	2	NA
1	1	1	13	7	1	NA	4	2	2	NA	1	2	NA
1	1	1	13	7	3	1	3	1	2	NA	1	2	NA
2	1	2	14	8	3	2	3	1	1	1	NA	NA	5
1	1	1	14	8	4	1	3	2	1	1	NA	NA	1
1	1	2	14	8	5	1	3	2	1	1	NA	NA	1
1	2	2	14	8	1	NA	4	1	2	NA	1	4	NA
1	1	1	14	8	2	2	4	1	2	NA	3	3	NA
1	2	1	14	8	3	1	4	2	2	NA	4	3	NA
1	1	1	14	8	1	NA	3	1	2	NA	4	3	NA
1	1	2	14	8	3	1	3	3	2	NA	2	3	NA
1	1	2	14	8	3	1	3	5	2	NA	1	3	NA
1	1	1	14	8	4	4	3	2	2	NA	1	3	NA
1	2	2	14	8	5	5	3	5	2	NA	1	1	NA
1	1	2	14	8	2	1	2	2	2	NA	1	1	NA
1	1	2	14	8	2	1	3	1	2	NA	1	1	NA
1	1	2	14	8	1	NA	3	1	2	NA	1	1	NA
1	1	1	14	8	2	5	1	1	2	NA	3	2	NA
1	2	1	14	8	1	NA	3	1	2	NA	2	2	NA
1	1	2	14	8	3	1	4	1	2	NA	1	2	NA
1	1	2	15	8	1	NA	3	1	2	NA	1	1	NA