

THE EFFECT OF ETHNICITY ON THE AGE-OF-ONSET  
OF THE MALE VOICE CHANGE

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The purposes of this study were to describe the characteristics of the changing male voice in 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> grade students using Cooksey's maturation stages and, to compare the age-of-onset of the male voice change in African American, White, and Hispanic male students. Participants included volunteer 4<sup>th</sup> ( $n = 61$ ), 5<sup>th</sup> ( $n = 73$ ), and 6<sup>th</sup> grade male students ( $n = 63$ ) from 2 urban elementary schools, 5 suburban elementary schools, 1 suburban middle school and 1 urban middle school in the North Texas region. The three ethnic groups represented in this study were: African American ( $n = 62$ ), White ( $n = 58$ ), and Hispanic ( $n = 77$ ).

Results indicated that approximately 46% of 4<sup>th</sup> grade participants, 62% of 5<sup>th</sup> grade participants, and 67% of 6<sup>th</sup> grade participants were classified as changing voices. A descriptively larger percentage of African American participants were classified as changing voices than Hispanic and White participants. Also, a larger percentage of African American and Hispanic participants were descriptively classified in the more advanced stages of the voice change than White participants. Urban African American, White, and Hispanic participants had a larger percentage of males classified as changing voices than suburban African American, White, and Hispanic participants. Results of a one-way, between subjects ANOVA revealed no significant main effect for ethnicity,  $F(2, 51) = .42$ ,  $p = .66$ ,  $\eta^2 = .02$ . The overall mean age-of-onset for participants in this study was approximately 11.20 years of age.

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## CHAPTER 1

### INTRODUCTION

It is widely understood that adolescence brings with it a myriad of challenges. Not only do children undergoing this transformation struggle to adapt to various psychological and physiological changes, but educators of these students also face great challenges in attempting to guide them successfully through this metamorphosis. Choral educators especially are forced to confront this issue as their students' voices begin to change. While girls experience minor changes in their voice during puberty (Gackle, 1991, 2000a, 2000b), the boys' voice change is far more severe (Cooksey, 1999). Great training is required in order to deal with these fragile voices. Not only should the choral educator understand the characteristics of the male voice change, but they should also demonstrate flexibility and patience in treating and guiding the students through the change (Stupple, 2007). Selecting appropriate music and assigning parts can often seem an impossible task for choral educators as the males in their choir are often in various stages of the voice change and their voices are unpredictable and often unstable.

#### Need for the Study

Over the past several decades, a clearer picture of the characteristics of puberty in males has developed allowing for a better understanding of these drastic physiological changes. Because of this, the music education community has had the opportunity to become more informed of the physiological effects of puberty on the male voice. While the physiological characteristics of the voice change have become clearer, conflicting methods and theories currently exist on how to guide male students through this difficult transition. Much of what has

been written regarding the male voice change has largely dealt in personal experience and theoretical understandings.

Historically, European choral directors and general music instructors dealt with the male voice during mutation as if it were a fragile vase that could easily “break” (Behnke & Browne, 1885; Eastman, 1929; Garcia, 1970; Johnson, 1906). Based on this theory, teachers largely prohibited male participation in their music classes and ensembles during the student’s voice mutation (Lorenz, 1998; McKenzie, 1956). Until the student’s voice had completed its descent, he received no training. Eventually traditional theory was replaced by a more modern theory, which held that males could continue singing during their vocal mutation under careful supervision (McKenzie, 1956). While some choral directors may still subscribe to the traditional theory, most music educators allow and encourage male participation during the vocal change (Cooksey, 1977; Cooksey, 1988).

Over the past few decades there has been an increase in scientific research regarding the male voice change, with the great bulk of studies being influenced by the work of Cooksey. Cooksey concluded that most males gradually progress through five stages during their vocal maturation. Subjects in Cooksey’s studies were categorized into one of the five stages, mainly based on their vocal range. His research largely focused on middle school aged boys since, during his early studies, it was believed that most males underwent maturation during the middle school years, but as his investigations continued he began to notice trends in the earlier onset of the male voice change (Cooksey, 1984). Other researchers have found evidence of earlier trends in male vocal mutation as well (Karr, 1988; Killian, 1999; Moore, 1995; Rutkowski, 1984). Rutkowski (1984) found that 50% of the 6<sup>th</sup> grade male students in her study could be classified as changing, whereas Killian (1999) concluded that approximately 80% of the 6<sup>th</sup> grade male

students in her study had entered Cooksey's voice change stages. Killian (1999) also included 5<sup>th</sup> grade male students in her sample and found that 50% had begun voice mutation. Medical research has confirmed that American males are beginning puberty at an earlier age (Herman-Giddens et al., 2001; Sun et al., 2002) and since the voice change is a secondary sexual characteristic, it is reasonable to assume that the voice change may be occurring earlier as well.

These trends that indicate that boys are entering adolescence at an earlier age may be of interest to the music education community. A large number of the textbooks and articles that have discussed the male voice change have been directed at the middle school/junior high choral director. While these publications have been helpful in bringing awareness to pedagogical concerns and recommendations, it may be that more information regarding the male voice change is necessary for elementary music educators since research has indicated earlier trends in the onset of the male voice change.

In addition to the need for more research regarding the age-of-onset of the voice change is a need for more information on the characteristics of the voice change in various ethnic groups. There currently is a notable absence of research in the field of music education regarding the male voice change in African American, White, and Hispanic students. It is clear that schools are increasingly becoming more racially and ethnically diverse. According to Fry (2006), between 1993 and 2003, enrollment in public schools increased to 46.6 million with Hispanic students accounting for 64% of the increase, African American students accounting for 23% of the increase, and Asian students accounting for 11% of the increase. White enrollment actually declined by 1%. Fry also found that while Hispanic student enrollment had continually increased in traditional Hispanic states (California, Texas, Florida, Arizona, Illinois, and New York), other states, categorized by Fry as "new settlement states" (North Carolina, Georgia,

Oklahoma, Kansas, Indiana, Virginia, Maryland, Nevada, Utah, and Oregon), had also seen increases in Hispanic student enrollment. These trends indicate that “minority” student populations are increasing throughout US. public schools with urban schools, in particular, becoming predominantly composed of minority ethnicities. Because of this increase in diversity throughout public schools, it may be important for music educators to become more aware of the unique characteristics that may be associated with each ethnicity

While recent reports have shown differences between ethnic groups in the onset of sexual maturation (Herman-Giddens et al., 2001; Sun et al., 2002), there is a shortage of evidence indicating whether ethnic groups vary in their age-of-onset of the voice change. With public schools becoming more diverse, it may benefit music educators to understand the characteristics of the age-of-onset of the male voice change in terms of ethnicity. This may be true if a certain ethnic group of males transitions into adolescence earlier than other ethnic groups. These students may have a more difficult time singing in the recommended range of their age group due to vocal maturation.

Another area that has received scant attention within the issue of the male voice change involves the type of school emerging adolescents attend – urban or suburban. Research comparing urban and suburban school settings has revealed differences in graduation rates with higher percentages of suburban students graduating (Toppo, 2008), as well as differences in student exposure to violence with a larger percentage of urban students being exposed to acts of violence (Campbell & Schwarz, 1996). These differences in graduation rates and exposure to violence may be attributed to rising disparities in the ethnic composition of urban and suburban school districts. Though both suburban and urban school districts, in many cases, represent minority student populations, individual urban schools are becoming more racially segregated

with some schools in the urban district composed of over 90% of one minority ethnic group (Fry, 2007). In addition to this recent trend, a larger representation of low-income minority students are attending urban, rather than suburban schools (Fry, 2007). There is a notable absence of research regarding the attributes of the voice change in urban and suburban males. If research in education has revealed some differences between urban and suburban students, it may be possible that unique characteristics of the voice change exist in urban and suburban emerging adolescents. Additional research may be necessary in order to better inform music educators of possible unique characteristics of adolescent male students in varying school settings.

In summary, a majority of published articles and books regarding the male voice change are directed at the middle school/junior high choral educator. If the voice change is occurring earlier, then this may not only affect secondary choral ensembles, but also the upper grades of elementary music. Therefore, more training may be required for elementary music teachers on the complexities of the male voice change. An adjustment in the music literature that is used in the music classroom may also be necessary. In addition, if males differ by ethnicity on the onset of the voice change, music teachers may need to be aware of these ethnic differences and make appropriate adjustments in instructional techniques to accommodate such differences in order for every student to be successful in the music classroom despite his ethnicity. Awareness of these possible differences may better inform the music educator and enhance proper instruction of male students during these pivotal maturation years.

### Purposes of the Study

The purposes of this study were to describe the characteristics of the changing male voice in 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> grade students using Cooksey's maturation stages and, to compare the age-of-

onset of the male voice change in African American, White, and Hispanic male students. The specific research questions were:

1. What are the characteristics of the voice change in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade male students?
2. What are the characteristics of the voice change African American, White, and Hispanic male students?
3. What are the characteristics of the voice change in male students of urban and suburban schools?
4. Do differences exist amongst African American, White, and Hispanic males in the age-of-onset of the male voice change?

### Definitions

To better inform the reader, the defining of operational terms used in this study is necessary. For the purposes of this study, lowest terminal pitch (LTP) will be defined as the lowest pitch of the vocal range that can be clearly delineated and highest terminal pitch (HTP) will be defined as the highest pitch of the vocal range that can be clearly delineated. The span of notes produced from the lowest terminal pitch to the highest terminal pitch will be defined as the participant's vocal range. Phonational gaps will be defined as areas in the singing range that are not sounded or phonated by the vocal cords. Pitch frequency will be defined as the number of sound waves per second measured in hertz.

In this study, the terms urban and suburban will be used for classification of school types. An urban school district will be defined as a district that lies predominantly within the boundaries of a large, metropolitan city. A suburban school district will be defined as a district that closely borders a large, metropolitan city.

Three ethnic groups were measured in this study – African American, White, and Hispanic. Most literature referring to ethnic groups has utilized the term White rather than

Caucasian, especially in regards to the topic of male puberty or the adolescent male voice (Curry, 1940; Herman-Giddens, Wang, & Koch, 2001; Hollien, Harry, & Malcik, 1962; Hollien & Malcik, 1967; Hollien, Malcik, & Hollien, 1965; Morris, 1997; Sun et al., 2002; Wang, 2002). For the purposes of this study, participants classified as White were persons of European and Middle Eastern descent. Participants classified as African American were persons of African descent. Participants classified as Hispanic were persons of Mexican, Puerto Rican, Cuban, Central or South American, or of other Spanish descent.

For the purposes of this study, a scale numbering system was necessary to coincide with the given pitch frequency. The lowest “C” on the piano will be defined by C1 extending to C8, the highest “C” on the piano. Semitones will be denoted by C#4 for the C# above middle C, as an example. The immediate octave above C1 will be C2 and so on as Figure 1 shows.

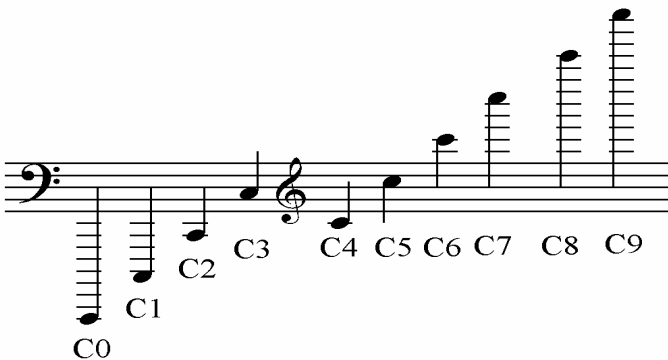


Figure 1. Scientific pitch notation.

### Limitations

The results and conclusions of this study should not be generalized beyond the sample and school districts used in this study. Though the school districts from which the sample was selected represent African American, White, and Hispanic ethnicities and were located in an urban or suburban area, they may not be representative of African American, White, and

Hispanic male students in urban and suburban school systems throughout the United States.

Also, the participants in this study were volunteers and therefore may not be the same as males who do not volunteer to participate in a research study.

Another limitation of this study concerns the Cooksey voice change stages utilized to classify the males in this study. Though research has validated this voice change classification system (Cooksey, 1984; Cooksey & Welch, 1998; Groom, 1984; Killian, 1999), the determination of the vocal range, which is used to classify the stage of voice change, remains subjective despite the steps I made to objectify each participant's vocal range. For instance, many researchers when measuring vocal range have required participants to match a stimulus pitch (Barresi & Bless, 1984; Cooksey, 1984; Groom, 1984; Hollien, Green, & Massey, 1994; Killian & Moore, 1997, Killian, 1999; Moore, 1991; Rutkowski, 1984; Wassum, 1979). This procedure for determining vocal range may be problematic because of the challenges with pitch matching associated with the male voice change (Collins, 1999; Cooksey, 1999). Accurately measuring the HTP and LTP of a male who cannot match pitch is difficult and increases the likely occurrence of measurement error. Such an error could lead to a misclassification of the voice change stage. In an attempt to prevent this problem, I utilized vocal exercises that did not rely on stimulus tones. Also, all vocal exercises were digitally analyzed in order to attempt to be more objective in determining each participant's HTP and LTP. It should also be noted that, because participants were recorded only once, they may have not truly sung as high or as low as their voice would allow.



## CHAPTER 2

### REVIEW OF THE LITERATURE

Within this review of literature, various topics regarding the voice change are discussed. First, the physiological characteristics of male puberty are presented with further discussion of the physical traits associated with the voice change. Next, theories of the male voice change are documented from a historical perspective. The literature review concludes by presenting recent research regarding the age-of-onset of the male voice change, as well as the consideration of ethnicity in regards to the voice change.

#### Physiological Characteristics Associated with Puberty

At the foundation of the issue of the male voice change is the topic of puberty. According to Tanner (1989), the first sign of puberty is testicular enlargement. Following this the skin of the scrotum changes in color and texture and the penis begins to enlarge. Pubic hair growth usually is not evidenced until these changes have begun. At the time of the publication of his book, Tanner (1989) documented that the penis growth usually begins around the age of 12.5 with some occurring as early as 10.5. Based on his research, he developed five stages (1 being pre-pubescent and 5 being adult) of sexual maturity for pubic hair and five stages for genital development. The Tanner stages are often used by medical researchers to track the development of adolescent boys.

Drastic changes not only occur in the reproductive organs, but seemingly in all physical areas of the body. The diameter of the head slightly accelerates, cartilage of the wrist grows and begins to turn into bone, and even heart growth speeds up (Tanner, 1962). Muscular and skeletal dimensions all accelerate in growth during this time. It is also predictable for males to increase

in height and to gain muscle mass and increased strength.

Another physical transformation that occurs during adolescence is the voice change. The female voice change emerges before the menarcheal onset (Thurman & Klitzke, 1994).

According to Kahane (1978), the female vocal folds increase in length by approximately 4 mm causing a slight lowering of the speaking fundamental frequency, breathiness and hoarseness in the voice, register breaks while singing, a rougher or heavier vocal quality, the need for more effort to produce sung pitches, and a decreased pitch range (Williams, Larson, & Price, 1996). Gackle (1991, 2000a, 2000b), a notable expert and prolific writer on the female voice change, developed a three-stage voice change classification system for the female changing voice – pre-menarcheal, post-menarcheal, and young adult female.

While the female voice encounters some change during puberty, the male voice change is more drastic and marks more significant physiological changes. During this mutational process, the thickness and length of the larynx significantly increases (Joseph, 1965; Luchsinger & Arnold, 1965; Tanner, 1962). According to Tanner (1962), this enlargement of the larynx occurs simultaneously with the accelerated growth of the adolescent's sitting height. Growth of the larynx causes the voice to deepen and coincides with the completion of the penis development (Tanner, 1962). The vocal folds also gradually lengthen up to 10 mm (Fuchs et al., 2007) causing a change in the voice frequency (Harries et al., 1998, Tanner, 1989). These physical changes tend to lower the voice approximately an octave in pitch, modify the timbre, and establish a more adult-like sounding male voice (Cooksey, 1999). Various vocal challenges can also accompany the voice mutation such as obvious phonational gaps (Cooksey, 1999; Willis & Kenny, in press), decreased vocal agility (Hook, 2005), range limitations, breathiness, vocal instability, and lessened control of dynamic contrast (Barresi & Bless, 1984; Cooksey, 1999;

Cooper & Kuersteiner, 1970; Harris, 1996; McKenzie, 1956). Fuchs et al. (2007) concluded that the speaking voice was the best predictor of voice mutation. Through acoustic analysis, Fuchs et al. discovered that non-audible mutations of the speaking voice occur around 6 months before singing voice mutations.

### Theories of the Male Voice Change

While basic agreement exists on the physiological characteristics of the voice change, great disparity has existed regarding its proper treatment. Centuries ago methods were devised to prevent the voice change from occurring all together. By removing the testicles of boys around the age of 8 or 9, it was discovered that they would not enter puberty. This method, known as castration, enabled boys to retain their treble voices. According to Weiss (1950), evidence of castrati can be traced back to 2000 BC. Castrati became especially popular in Italy during the 17<sup>th</sup> and 18<sup>th</sup> century. With the invention of the opera, castrati rose to celebrity status. Because they had been trained from childhood, these castrati had developed powerful voices that were very agile and flexible. Composers wrote specifically to the strengths of these virtuoso singers. Around the middle of the 18<sup>th</sup> century though, sentiment and admiration for the castrati voice began to wane. The act of castration began to be thought of as somewhat inhuman in that a person's manhood would be sacrificed to simply maintain a beautiful, pure treble voice. Many of the themes of the operas of this time dealt with strong, mythological characters like Hercules and Jupiter, and to hear feminine treble voices singing those roles became unreasonable to the audience. As Mozart began to write operas that dealt with more realistic characters, the castrati practice became outdated and the mature male adult voice was desired. Though the secular popularity of the castrati had diminished, some monasteries and cathedrals still maintained the

castrati voices even into the 19<sup>th</sup> century (Swanson, 1977). There is even evidence that the Sistine chapel employed castrati until 1903 (Jenkins, 2000).

By the middle of the 19<sup>th</sup> century, a new theory concerning the male voice change had emerged. Manuel Garcia, a famous voice teacher and inventor of the laryngoscope, published a treatise on the art of singing in which he discussed the mutating voice. He wrote:

During this time of crisis, it is necessary to let nature, the only dispenser of individual powers, act. In this age of regeneration, the individual could not be too economical of these powers, nor take much care of his constitution. If one impoverishes the vocal organ by the practice of singing, or by any excesses whatsoever, one exhausts the plant before it is fit to give fruit; one causes decay to succeed childhood. (p. xxix)

He went on to write that individuals should not seriously study singing until after the voice mutation had concluded. For males, they could continue study after their voice had dropped an octave. This stirred a great controversy between Garcia and Mackenzie over this subject.

Mackenzie, a noted English laryngologist, contended that because the voice change was gradual, it should be exercised and developed under careful supervision (Weiss, 1950). This controversy between Garcia and Mackenzie and their rival camps continued into the early 20<sup>th</sup> century. It is widely believed that it was Garcia that instigated what is commonly referred to as the “voice-break” theory, which would be practiced by vocal educators throughout the next century (Cooksey, 1988).

Many voice teachers and choral directors throughout Europe adopted Garcia’s view of resting the voice during the mutation as evidenced in the practices of various boys’ choirs throughout Europe. The Vienna Boy’s Choir would release or remove members of the choir as their voices began to “break.” After years of intensive training and privileged performances before royalty, these boys were dropped from the choir and received no further training in voice.

They were instead offered training in composition, theory, or perhaps another instrument

(Lorenz, 1998). Swanson (1977) wrote:

With such exceptional background and training for an advance start it would seem likely that the graduates of this choir would be far to the front in the professional fields of concert, oratorio, and opera singing. Yet in reading the trade magazines dealing with musical performers the world over, we find almost no distinguished male singers who claim as part of their background membership in this famous boy choir school. (pp. 73-74)

He went on to write:

I suggest that these shocks – the abrupt dismissal when the voice “breaks,” the transfer from an environment of glamour and adulation, of singing in many countries before large audiences to a style of life that could be called living in obscurity; the implication that now that the voice has broken, a singing career has come to an end; the lack of any school ready to accept these graduates and carry on with their vocal development, the lack of financial means for independent study, all of these are too much of a hurdle for a fourteen or fifteen-year-old boy to surmount. (p. 74)

### *British Male Voice Change Theories*

In the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, the debate in England over voice change theories increased. The traditional theory, based largely on the principles espoused by Garcia, held that males should avoid singing during their voice change or “voice break” to avoid injuring the voice. The modern theory, however, contended that since the voice changes gradually, a boy may sing throughout that period as long as instruction is delivered properly. Behnke and Browne (1885) provided the first published account of this debate in *The Child’s Voice: Its Treatment with Regards to After-Development*. They contended that evidence showed that exercising the voice during the voice change period was injurious and could have harmful consequences. While they did acknowledge that not all boys’ voices break and that boys may continue to sing if this break does not occur, they presented a definite bias toward the theory to which they subscribed. Moody (1939), organist of Ripon Cathedral agreed with the “voice break” theory

and promoted the idea of vocal rest for 3 years during the mutation period. Likewise, Wood, in his book, *The Gentle Art of Singing* (1930), agreed by stating that a boy should “leave off work with his voice for 2 or 3 years after it has broken” (p. 22). This theory became practice not only in boy choirs throughout Europe, but especially in church choirs and school music classes in England (McKenzie, 1956).

Not all music educators agreed with this theory. Winn, H. M. Staff Inspector of Music in Schools, Ministry of Education argued that boys’ voices do not break (McKenzie, 1956). In a letter to the editor published in *The Musical Times* in September of 1929, Eastman strongly disagreed with the view of Winn:

The statement attributed to Winn, Inspector of the Board of Education, that boys’ voices do not break, should not be allowed to go unchallenged.

Whether they ought to break may be another matter, but that is a question which should be left to the doctors – throat specialists... Boys’ voices are often broken through using the voice too much and in the wrong way. It is an unfortunate fact that the majority of those entrusted with the training of young singers, such as church organists, school teachers, &c., have very little knowledge of voice-production. The damage done by these people is chiefly apparent to those teachers who have to train the adult voice. I can honestly say that in my experience the hardest voices to train are those of men who have been solo choir-boys. Such voices are often permanently injured as the results of over-use of the boy’s voice, and wrong methods of production acquired in the choir or school room. (p. 840)

The traditional theory espoused by Eastman in the previous quote heavily influenced the type of music published during the early 20<sup>th</sup> century in England. Music published in English schools was mainly unison and two-part (McKenzie, 1956) until the 1930s when two song books, *A Heritage of Song: A Song Book for Adolescent Boys* (1932) by McLeod, and *Clarendon Song Book for Boys with Changing Voices*, Books 1, 2, and 3 (1935) by Wittaker, Wiseman, and Mellalieu were published. In the preface to McLeod’s songbook, he wrote that the debate over the proper treatment of the male voice change had depleted male participation in school music and that the neglect of vocal training during the period of vocal rest had greatly impaired male

vocal quality throughout England. The preface of *Clarendon Song Book for Boys with Changing Voices* countered the theory of the “voice break” and instead argued that the voice change was a gradual and completely natural process and, with proper training and care, boys could sing throughout this period (McKenzie, 1956).

While many still subscribed to the “voice break” theory, the tide in England was turning to a more modern theory, which encouraged continuous singing through the voice change. One of the most prominent English music educators to speak on the subject of the male voice change was McKenzie. Before McKenzie, the debate over the male voice change mainly revolved around taking the side of either the traditional or modern theory. By the middle of the 20<sup>th</sup> century, the modern theory had become widely accepted and practiced by most English music educators; however, little was promoted concerning effective methods for training boys during the voice change.

*McKenzie’s theory.* In 1956, McKenzie’s book, *Training the Boy’s Changing Voice*, presented his view of the male changing voice marking the first publication of a practical guide to training the adolescent boy’s voice. He contended that the male voice went through distinct stages during the mutation period. With this gradual lowering of the voice, changes in the tone quality of the voice were evident. McKenzie wrote that the most reliable predictor of the voice change was the speaking voice. As the speaking voice began to lower, the singing voice would follow. It was his theory that the unchanged voice could be classified as Soprano I, but as the mutation began, it would gradually lower to Soprano II, then to alto. Normally, the next voice part in this descent of vocal range would be tenor, however, he reasoned that while boys in this stage could sing most of the notes associated with the tenor voice part, the vocal quality was not that of a boy or a man. Because of this, he developed the “alto-tenor” plan. The boy would then

progress to either tenor or baritone/bass depending on the rate of his voice change. His book not only offered his theory on the voice change and the “alto-tenor” plan, but also offered rehearsal techniques, actual student case studies which tracked the stages of the voice change, as well as various methods used in other countries to deal with the male voice change. This book was not only influential in England, but practice of his “alto-tenor” plan also became prevalent in America (Gehrkens, 1936).

### *American Male Voice Change Theories*

While British music educators and scholars debated the traditional and modern theories of the voice change, there was little evidence of such a debate in the United States. Johnson, in his book *The Training of Boys’ Voices*, wrote that “boys, while capable of much more vocal work before maturity than girls, should rest from singing during their change of voice” (1906, p. 6); however, this is one of very few promotions of the traditional theory uncovered in American publications in the 20<sup>th</sup> century. Gehrkens noted in *Music in the Junior High School* that American music educators were highly aware of the theories promoted and debated in England. He wrote:

The older plan of training boys’ voices, as inherited from the English school of choirmasters, was to keep the boy singing soprano as long as possible and then letting the voice “break.” Often it broke all to pieces and never recovered, and in any case there was usually a period when the boy could scarcely sing because he had suddenly acquired a voice that he could not manage at all. After this he began all over again, learning to sing tenor, baritone, or bass as the range and quality of his voice dictated; or not singing the rest of his life – as frequently happened. The more modern plan is to encourage the boy to sing second soprano when his high tones begin to be less clear or less easily produced, and especially as lower tones develop; and, similarly, to sing alto as the voice goes down still farther, this being followed by a more devised part called *alto-tenor*, which has a very small range midway between alto and tenor. (1936, p. 72-73)

In this passage it is clear that McKenzie’s “alto-tenor” plan was already understood and in



practice in America even before his book was published. The literature in American music education journals suggests that American vocal music educators were more concerned as to how to train and classify the male changing voice rather than debating whether or not he should sing during mutation. With the creation of the junior high school in America during the early part of the 20<sup>th</sup> century, choral directors were forced to either train the changing male voice, or risk not having male representation in the chorus.

A trend towards same-gender music education classes in junior high schools began to emerge in the 20<sup>th</sup> century. In a sub-committee report from the Music Supervisors National Conference, Wisenall (1930) recommended segregating girls and boys in junior high music classes in order to focus on the unique challenges of the male voice change. This report also recommended frequent testing for the boys in order to assign “the part which is most comfortable for them to sing” (p. 51). Committee members also offered practical suggestions for instruction and training of the changing voice and insisted that the teacher must be a voice specialist, not just a trained singer. Evidence of this report reveals one of the first collaborative efforts of a music education organization to address the complex issue of the male voice change.

*Cooper's theory.* By the middle part of the 20<sup>th</sup> century, several prominent American male voice change theorists emerged. Cooper was a prolific contributor to junior high school choral music. Most noted for his book, *Teaching Junior High School Music* (1970), Cooper also published several articles in popular music education journals and arranged music designed for the junior high school chorus. He was responsible for coining the term “cambiata” (nota cambiata – changing note), which was similar to McKenzie’s “alto-tenor” plan. He made a distinction between the two terms by explaining that the alto-tenor range extended “from F below middle C upwards an interval of a sixth or seventh, whereas, the cambiata extends

upwards to octave middle C” (Cooper, 1950, p. 21). McKenzie’s book, however, identified the “alto-tenor” range as G below middle C to A or C above middle C (1956, p. 21). Regardless of this discrepancy, Cooper’s primary concern was to adequately describe the aspects of the voice mutation and its effects on the male voice.

Cooper also sought to educate junior high school choir directors about the challenges of the voice change and to provide them with tools and techniques they could use to maneuver the mutational period. In his writings, he advised teachers to test their students in order to identify what voice change stage they should be classified in according to their range. This was recommended so teachers could select appropriate literature based on the male students in their class and to place those students on the voice part that best fit their voice range. He not only tried to educate teachers on appropriate literature for changing voices, but also arranged several pieces for junior high school choirs that contained a “cambiata” part in the score.

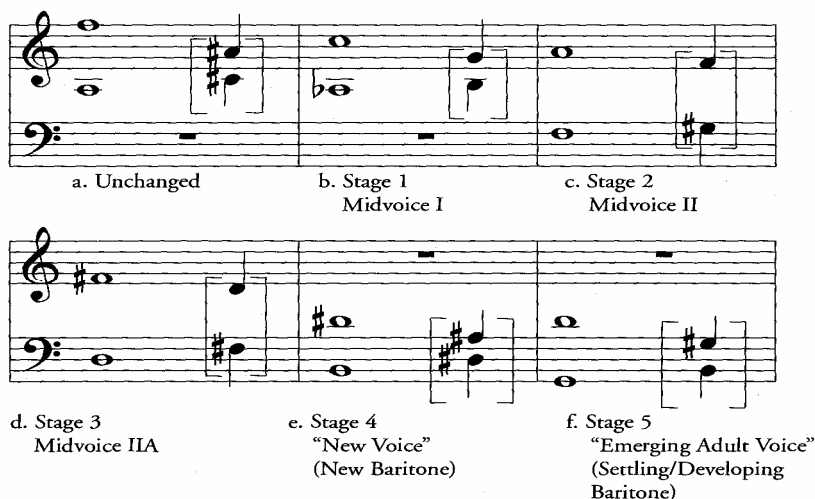
*Swanson’s theory.* Another influential theorist on the male voice mutation was Swanson. Swanson, who once served as director of the Moline, Illinois Boy’s Choir, became one of the first music education scholars to scientifically study the male voice change using experimental research (Swanson, 1959). Using the Shuttleworth Pictorial Atlas, which contained a series of five photographs identifying the stages of sexual development among boys, he found that the physical stages of sexual development, particularly pubic hair growth, were the best predictors of voice change. Though at the time his method of collecting such data stirred some controversy, his findings have provided great assistance in better understanding physical predictors of the male voice change. Through his publications, which included two books, *The Male Singing Voice Ages Eight to Eighteen* (1977) and *Music Teaching in the Junior High and Middle School* (1973), he did much to bring awareness to the peculiarities of the male voice change.

Unlike many theorists, he proposed that the voice change was not always a gradual process and could not be easily classified as the Cooper and McKenzie theories promoted. He wrote that “boys sometimes make the transition from treble to changed-bass very quickly and very radically, and the good teacher must change materials and techniques just as rapidly” (Swanson, 1961, p. 63). Because of Swanson’s contributions, new light was shed on the existence of basses in the middle school choir. Both Cooper and McKenzie thought the existence of basses in the middle school/junior high level to be rare. Swanson’s research, however, revealed the “pulse register” often referred to as “fry tones” or the “Russian bass,” which refers to young men who are able to sing the octave below the bass clef. He argued that many music teachers label males with a limited and low range as deficient singers, when, as he believed, they may be developing their “pulse register” (Swanson, 1984, p. 49). In referring to Cooper’s “cambiata” theory and McKenzie’s “alto-tenor” plan he wrote that their theories “are legitimate if they are used to identify a method of adapting music to a teaching situation. They do not identify a singing voice as do the well-understood terms soprano, alto, tenor, and bass” (Swanson, 1961, p. 66).

*Cooksey’s theory.* Perhaps the most influential theorist for our current understanding and treatment of the male voice change is Cooksey. Cooksey, who served as professor of music education at the University of Utah, has published numerous books and articles aimed at studying the male voice change and providing practitioners with recommendations for effective training of adolescent males. Cooksey’s eclectic theory of the male voice change was drawn from elements of McKenzie, Cooper, and Swanson’s theories. Like his predecessors, he not only tried to educate the music teacher about the characteristics of the male voice change, but also provided suggestions for training and classifying these voices. In his book, *Working with*

*Adolescent Voices*, he offered advice on assigning voice parts and how to go about classifying each singer (Cooksey, 1999). He also provided vocal exercises to use with students enduring the voice mutation as well as suggestions for literature selection.

Cooksey’s research included several longitudinal studies from which he developed five developmental stages of the changing male voice (Midvoice I, Midvoice II, Midvoice IIA, new baritone, and settling baritone). The last two stages were later renamed “new voice” and “emerging adult voice” respectively (Cooksey, 1999; Cooksey & Welch, 1998). Figure 2 portrays the range and tessitura for each stage. These stages are reminiscent of both McKenzie’s and Cooper’s stages. It was Cooksey’s assumption that the male voice change was predictable and he established clear criteria for assigning the changing voice classification: 1) pitch range, 2) tessitura, 3) vocal quality, 4) register development, and 5) average fundamental speech frequency (Cooksey, 1999; Cooksey & Welch, 1998). Barresi and Bless (1984) determined that tessitura was not a reliable measure of voice change, causing Cooksey (1984) to concede that “range is the single most important factor for delineating different stages of voice development” (p. 7).



Bracketed notes—tessituras

Figure 2. Cooksey’s voice change stages (mean ranges and tessitura). [From *Working with Adolescent Voices* (p. 13), by J. M. Cooksey, 1999, St. Louis: Concordia. Copyright 1999 by the Concordia Publishing House. Reprinted with permission (License Number 08:07-11B).

Various studies have verified the validity of Cooksey's stages (Cooksey, 1984; Cooksey, 1985; Cooksey & Welch, 1998; Groom, 1984; Killian, 1999). Also, Harries et al. (1997) found that Cooksey's stages correlated with Tanner's stages of development. Cooksey also concluded that the fundamental speaking frequency, which he identified by having subjects count backwards from 20 to 1, was the best determinant for locating the lowest terminal pitch. He and other researchers have found that the fundamental speaking frequency is approximately 3 to 4 semitones above the lowest terminal pitch (Cooksey, 1988; Groom, 1979; Killian, 1999). This finding indicates a strong relationship between the changes occurring in speaking voice and singing voice.

Since the development of Cooksey's voice change stages, a plethora of research concerning the male voice change has been conducted. The issue of training the changing male voice has been evaluated by various researchers (Chapman, 1989; Kennedy, 2004; Killian, 2003; Usher, 2005). In a qualitative study, Kennedy (2005) observed and interviewed members and instructors of the American Boychoir School. She concluded that because each male's voice change experience was unique, the choral director must be careful to frequently monitor the physical and aural symptoms of each young singer and help to guide each singer through the frustrations associated with vocal change. She also found that providing the adolescent singer with knowledge of quality vocal technique and the limits of his vocal capabilities would help to protect him from vocal injury during the maturation years.

Killian (2003) surveyed choral educators on self-reported accommodations made for changing male voices and found that a majority of the participants responded that they encourage or allow their boys to sing their part an octave lower than written as a strategy for accommodating the voice change. Some respondents admitted to assigning their boys non-

singing duties during their voice change. Seventh and 8<sup>th</sup> grade choir teachers in Usher's (2005) study reported poor teacher preparation in regard to the physiological aspects of the male voice change, testing and classification of the voice change, and adapting voice parts for middle school choir. She also concluded that those choir directors who individually tested their male students' voices had more success at musical competitions than those choir directors who did not.

Other literature has investigated the psychological aspects of the changing male voice. Kriekand (2001) performed an action research study on the perceptions of adolescent males during the voice change by interviewing 8<sup>th</sup> grade male members of her choral ensemble. She reported that the boys felt at ease with their vocal mutation and that their choir director (the researcher) and parents treated them positively throughout the maturation process. Killian (1997) surveyed and interviewed boys with changing voices and adult men on their perceptions of the voice change process. She noted that some participants had emotional responses when recalling the memories of their voice change. The majority of the participants in Killian's study reported the voice change process to be a negative experience. Singers seemed to be much more aware of the voice change than non-singers and reported feeling physical pain and hoarseness during their voice change. Several adult male participants responded that the quality of their mature voice was not as good as their pre-pubertal voice.

#### Age-of-Onset of the Male Voice Change

Another area of research on the male voice change that has received great attention is the age-of-onset of the voice change. The mean age of the voice change onset in 1939 was approximated at 14.25 years (Sturdy, 1939). By 1971, the age had decreased to 13.8 years (Friesen, 1972) and in 1978 had reduced to the mean age of 13.5 years (Cooksey, 1984).

Hollien, Green, and Massey (1994) measured the vocal range and speaking fundamental frequency of 48 males over a 5-year period and concluded the age-of-onset of the voice change to be 13.4 years; however, the researchers did not use Cooksey's voice change stages but rather a three-stage classification – preadolescent, adolescent, and postadolescent. Other studies that have used the classification system of Cooksey's voice mutation stages have found similar trends in the earlier onset of voice change (Barresi & Bless, 1984; Karr, 1988; Killian, 1999; Moore, 1995; Rutkowski, 1984). Barresi and Bless (1984) measured 59 7<sup>th</sup> and 8<sup>th</sup> grade male choir students and concluded the age-of-onset of the voice change to be 12.8 years. Most recently, Killian (1999) performed a study using 99 5<sup>th</sup> and 6<sup>th</sup> grade subjects. Of the 56 5<sup>th</sup> graders in this study, 50% had already entered one of Cooksey's voice change stages. Only 8 of the 43 6<sup>th</sup> grade students were unchanged. According to Killian, 81.4% of the 6<sup>th</sup> grade subjects could be classified into one of Cooksey's stages where as Rutkowski (1984) found only 50% of 6<sup>th</sup> grade subjects in her study to be changing. It should be noted that only 10 6<sup>th</sup> grade males were measured over a 2-year time span in Rutkowski's (1984) study and that all of those participants were members of the middle school choir. Karr (1988) concluded that 70% of the 10 6<sup>th</sup> grade male voices in his study were unchanged.

An earlier onset of vocal change may be in alignment with recent studies performed in the medical community that have shown the onset and rate of male maturation to be occurring earlier (Herman-Giddens et al., 2001; Sun et al., 2002). According to data collected from the National Health and Nutrition Examination Survey III released in 1997, the mean age for those in Tanner Stage 2 of pubic hair growth was 11.8 and the mean age for those in Tanner Stage 2 of genital development was 10 (Herman-Giddens et al., 2001). While these earlier trends may be alarming, Reiter and Lee (2001) warned that some subjectivity is involved when categorizing

subjects into Tanner stages. Reiter and Lee (2001) also argued that while males may be beginning puberty earlier, the completion of puberty remains in line with previous research. This phenomenon may also be isolated to the United States. Juul et al. (2006) studied Danish children in order to compare the data with European and United States data. They discovered no decrease of age in the onset of puberty for Danish subjects.

Various causes for the earlier trends of puberty have been offered. Some have argued that environmental factors have been the cause (Schrama & Juul, 2006) while other research has noted the effects of obesity on puberty (Wang, 2002). Research regarding possible causes remains inconclusive. Nevertheless, these studies could confirm and explain the reported trends of earlier voice mutation in males.

#### Ethnicity and the Male Voice Change

One important variable that has received scant attention in the discussion of the male voice change is ethnicity. Race and ethnicity have been topics of interest in the field of music education since the Tanglewood Symposium in 1967, which emphasized an increased implementation of multicultural and world music in the music education curriculum (Mark, 1999). More attention was centered on music education in urban schools, which was more representative of minority populations. Numerous pedagogical music education documents have focused on the use of multicultural music as a means of expressing value of other races and ethnicities represented in the music classroom (Abril, 2006; Anderson, 1992; Belz, 2006; Campbell & Schupman, 1992; Carolin, 2006; Fung, 1995; Goetze, 2000; Gonzo, 1993; Goodkin, 1994; Henderson, 1994; Kelly & Van Weelden, 2004; Parr, 2006; Yudkin, 1993).

While pedagogical music education journals have devoted extensive attention to issues



involving race and ethnicity in music, music education research has largely ignored ethnicity as a variable of foremost interest. Ebie (2002) investigated the characteristics of participant samples found in the *Journal of Research in Music Education* from 1953-2002. He found that only 10 studies in the *JRME* included participant samples of specific ethnicities. Those studies in the field of music education that have focused on ethnicity have largely dealt with instrument choice/assignment (Johnson & Stewart, 2004, 2005) and preference for types of music (i.e., cultural or world music) (Abril & Flowers, 2007; Killian, 1990; McCrary, 1993, 2000; McCrary & Gauthier, 1995, McCrary, 2000; Morrison, 1998).

Music education research regarding ethnicity and the male voice change is notably absent. A review of the literature revealed only a small number of studies that investigated ethnicity and the adolescent voice. Most of those articles were found outside of the field of music education. Curry (1940) analyzed the speaking fundamental frequencies of three groups (10 year olds, 14 year olds, and 18 year olds) of northern White males and found that the voice change occurred between the ages of 14 and 15. Hollien and Malcik (1962) studied the voice characteristics of three groups of African American southern males and compared the results to Curry's (1940) findings. Hollien and Malcik found that the African American males in their study had lower median speaking fundamental frequencies than the White males in Curry's study. In a follow-up study, Hollien, Malcik, and Hollien (1965) measured three groups of White southern males and compared the results to the Hollien and Malcik (1962) and Curry (1940) studies. They found that no differences in the onset of the voice change existed between the White and African American southern males, which led them to speculate that other variables may have accounted for the differences between the southern African American males and northern White males. Hollien and Malcik (1967) then studied three groups of northern White

males and found earlier trends in the onset of the male voice change as compared to the previous studies. Analysis of the results from the Curry (1940), Hollien and Malcik (1962), Hollien, Malcik, and Hollien (1965), and Hollien and Malcik (1967) studies led Hollien and Malcik (1967) to conclude that the voice change may occur before the age of 14, that African American and White males may encounter the voice change at the same age, and that differences in climate may not account for differences in the onset of the male voice change.

Similar results were found in the Morris (1997) study, which compared the speaking fundamental frequencies of 8- to 10-year-old White and African American males. No significant differences in the speaking fundamental frequencies of White and African American males in the study were found. It should be noted that all of the studies discussed previously did not use the Cooksey voice change classification system and only measured the speaking fundamental frequencies of the male participants. The SFF (speaking fundamental frequency) was determined by analyzing a read passage. Specific criteria for selecting the participants in the studies were used because of the reading requirement. Also, no information was provided as to the process or criteria for determining the onset of the voice change.

Hughes (1984) analyzed the voice change in White and African American males by utilizing Cooper's voice change classification system (unchanged, changing, changed). Participants' ages ranged from 10 to 14 years old and represented Grades 5 through 8. Vocal range was assessed in a group setting by having the students sing "Jingle Bells." Based on which octave the participants were singing in, they were categorized as unchanged, changing, or changed. Results revealed that a larger percentage of African American participants at age 10 could be categorized as changing voices than White participants. Approximately 32.0% of White participants at age 10 were classified as unchanged voices as opposed to only 12.9% of African

American participants. Hughes (1984) found that the African American participants and White participants differed in the progressive pattern of the voice change. Information regarding the characteristics of the voice change in Hispanic males is notably absent in the literature.

Recent medical research has offered probable cause for speculating that perhaps male ethnic groups do in fact differ regarding puberty and development. According to contemporary reports, African American boys and girls had earlier median and mean ages for sexual maturation than White and Hispanic boys and girls (Herman-Giddens et al., 2001; Sun et al., 2002). Statistical significance was found in the difference among these three ethnic groups in the median ages of the onset of pubic hair growth and genital development at specific Tanner stages of development, with an earlier age of maturation being found for African American boys (Herman-Giddens et al., 2001). According to Sun et al. (2002), the median age for the onset of pubic hair development in African American boys was approximately 11.2 years, approximately 12.0 years for White boys, and 12.3 years for Hispanic boys. Herman-Giddens et al. (2001) found that African American boys entered the onset of genital development at 9.5 years with White males and Hispanic males entering genital development at ages 10.1 and 10.4 respectively. Though there appear to be differences in the onset and stages of maturation among ethnic groups, Sun et al. (2002) found that both boys and girls completed sexual development around the same ages regardless of their ethnicity.

### School Setting and the Male Voice Change

Another component of the voice change that has received scarce consideration in the field of music education concerns the characteristics of the voice change in urban and suburban school adolescent males. A growing body of literature has been devoted to comparing urban and

suburban school districts. Much of this literature has evaluated health risk behaviors of urban and suburban adolescent students with results indicating no differences between urban and suburban school students for risk behaviors such as tobacco, alcohol, and illegal substance, as well as sexual activity (Atar & Spencer, 2002; Greene & Forster, 2004; Levine & Coupey, 2003). Green and Forster (2004) found that in some cases, suburban adolescents had greater occurrence of risk behaviors than urban adolescents.

Other studies comparing urban and suburban school students have revealed strong differences. Campbell and Schwarz (1996) evaluated the exposure to and impact of violence among urban and suburban middle school students, and found that a greater percentage of urban middle school students were exposed to violent episodes in their daily lives than were suburban middle school students. Subjects reported physical and psychological effects of this exposure to violent crime such as headaches, fearful thoughts, and sleep deprivation.

Differences have also been documented between urban and suburban schools for academic achievement. A recent report found large gaps between the graduation rates of urban school districts and suburban school districts (Toppo, 2008). For example, Dallas Independent School District was reported to have a graduation rate of 55.8% in comparison to surrounding suburban districts which posted a 74.7% graduation rate (Toppo, 2008). This trend can be seen throughout the US.

Much of the differences found between urban and suburban districts may be accounted for by the disparities in ethnic demographics. Current trends seem to indicate that low income Hispanic and African American students are more predominantly populating urban schools as wealthier White students migrate to newer schools located in suburban districts (Fry, 2006). These urban schools are also becoming more racially segregated as African American and

Hispanic students become more isolated from White students and from each other within the urban districts (Fry, 2007). According to Fry (2007), the factors affecting these rising levels of ethnic segregation are related to the geographic diffusion of ethnic groups, residential housing, and desegregation policies instituted by various school districts across the country. Research also reveals that urban school buildings tend to be much older than suburban school buildings and are often located in poorer communities (Fry, 2007). These trends may account for differences found between urban and suburban school academic achievement.

Research on urban and suburban school students is scarce in the field of music education. Shields (2001) implemented a performance music ensemble program into an urban middle school for at-risk students and reported mixed findings on the importance of music education as an effective intervention for at-risk urban students. Music education pedagogical literature has devoted attention to urban school issues (Fiese & DeCarbo, 1995; Frierson-Campbell, 2006a; Frierson-Campbell, 2006b; Hinckley, 1995; Kindall-Smith, 2004; Mixon, 2005). Despite the vast literature regarding music education in urban school settings, many urban music teachers have felt “woefully unprepared to teach in the urban setting” (Fiese & DeCarbo, 1995, p. 28). Carter (1994) argued that a better understanding of minority student populations was needed by music educators in order to be more successful in urban settings.

## Conclusion

Adolescent males encounter various challenges as their body rapidly develops. In addition to these physical developments, the male larynx grows and the vocal folds lengthen causing the voice to lower and modify in timbre. Through this period of vocal maturation come various challenges, which include range limitations, phonational gaps, vocal instability, and

breathiness. Various music educators and scholars have posited theories of the male voice change including McKenzie, Cooper, Swanson, and Cooksey. Recent research has used and validated the classification system developed by Cooksey as an effective means of tracking the male voice mutation process.

In using Cooksey's maturational stages, researchers have detected an earlier age-of-onset of the male voice change. The earlier onset of the male voice change is in alignment with recent medical research, which indicates an earlier onset of puberty in males. According to Killian (1999), 50% of the 5<sup>th</sup> grade males tested in her study could be classified into one of Cooksey's voice change stages. If 50% of 5<sup>th</sup> grade students have begun the voice change, it is quite probable that some 4<sup>th</sup> grade males may also be beginning their vocal mutation. Recent medical research has also indicated that males differ in the age-of-onset of puberty by ethnicity, yet research that compares or describes the male voice change by ethnicity is scant. Also, research is lacking on the characteristics of the voice change in urban and suburban school male adolescents. Based on this review of the literature, there is a need to examine further the characteristics of the male voice change in earlier grades than previously measured and to compare the age-of-onset of the male voice change in African American, White, and Hispanic students.

## CHAPTER 3

### METHOD

In this chapter, the methodology used for this study is discussed. The purposes of this study were to describe the characteristics of the changing male voice in 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> grade students using Cooksey's maturation stages and, to compare the age-of-onset of the male voice change in African American, White, and Hispanic male students. The sample selected for this study is described as well as the procedures employed. The validity and reliability of the vocal range measurement is also presented.

For purposes of this study, participants ( $N = 197$ ) consisted of volunteer 4<sup>th</sup> ( $n = 61$ ), 5<sup>th</sup> ( $n = 73$ ), and 6<sup>th</sup> grade male students ( $n = 63$ ) from two urban elementary schools ( $n = 28$ ), five suburban elementary schools ( $n = 125$ ), one suburban middle school ( $n = 6$ ) and one urban middle school ( $n = 38$ ). Three of the five suburban elementary schools included 6<sup>th</sup> grade students. All schools were located in the North Texas region and included three large public school districts. Participants included elementary general music students ( $n = 153$ ), 6<sup>th</sup> grade band and orchestra members ( $n = 16$ ), and 6<sup>th</sup> grade students not in a music ensemble ( $n = 28$ ). Ages ranged from 3547 days old (approximately 9.72 years old) to 5013 days old (approximately 13.73 years old) ( $M = 4175.44$ ,  $SD = 332.46$ ).

Because of the need to find possible trends in the male voice change based on ethnicity, schools were purposively sampled. I reviewed the published demographics of schools to find those that were representative of the three male ethnic groups needed for this study. The primary criterion for school selection in this study was proportional representation of African American, White, and Hispanic students. This was done by researching the published 2006-2007 AEIS (Academic Excellence Indicator System) results on the Texas Education Agency website

(<http://www.tea.state.tx.us/perfreport/aeis/2007/campus.srch.html>). Though the main purpose of AEIS reports is to evaluate standardized test scores for each district and school, the reports also contain detailed records of the demographics of each school in the state of Texas.

The three ethnic groups represented in this study were: African American ( $n = 62$ ), White ( $n = 58$ ), and Hispanic ( $n = 77$ ). Table 1 shows the ethnic group representation from this study separated by grade and school type (urban and suburban).

Table 1

*Ethnic Group Representation by Grade and School Type*

Ethnic Group	4 <sup>th</sup> grade		5 <sup>th</sup> grade		6 <sup>th</sup> grade	
	Urban	Suburban	Urban	Suburban	Urban	Suburban
African American	4	13	7	23	5	10
White	1	24	1	11	11	10
Hispanic	7	12	8	23	22	5
Total	12	49	16	57	38	25

Once the schools were identified as being proportionately representative of African American, White, and Hispanic students, district administrators were contacted in order to obtain permission to perform the study within their school district. Originally, four districts were contacted after meeting the established criteria, but one district did not grant permission to participate in this study due to policies restricting research projects by researchers outside of the district. Upon receiving permission from each of the three remaining district representatives, each prospective school administrator was contacted and informed of the details of the study. Once each school administrator granted permission to have the school's students participate in



the study, the elementary music teacher (or the middle school electives coordinator) was then contacted and informed of the data collection procedures. I then visited each school to recruit participants. The suburban middle school principal only granted permission for me to recruit males from the music elective classes (band, orchestra, and choir).

### School Districts

Three large public school districts in North Texas granted permission to conduct this research study using students from the selected schools in their district. According to 2006-2007 AEIS reports, the first district served approximately 158,126 students and employed over 10,000 teachers in 221 schools. In Grades 4-6, the student population was approximately 35,271. The following ethnicities were represented in the overall student population: African American (29.6%), White (5.0%), Hispanic (64.2%), Native American (0.2%), and Asian (0.9%). Though the overall demographics for this district were not proportionately representative of the ethnic groups measured in this study, the three selected schools within this district were representative of African American (25.5%), White (30.9%), and Hispanic (40.9%) students. Approximately 83.9% of the overall student population was recorded as economically disadvantaged.

The second district served approximately 35,000 students and employed over 2,500 teachers in 57 schools. In Grades 4-6, the student population was approximately 7,432. The following ethnicities were represented in the overall student population: African American (26.0%), White (34.5%), Hispanic (31.2%), Native American (0.4%), and Asian (7.9%). Approximately 49.4% of the overall student population was recorded as economically disadvantaged.

The third district served approximately 26,163 students and employed over 1,800

teachers in 35 schools. In Grades 4-6, the student population was approximately 5,780. The following ethnicities were represented in the overall student population: African American (14.2%), White (25.8%), Hispanic (48.8%), Native American (0.4%), and Asian (10.8%). Though the overall demographics for this district were not proportionately representative of the ethnic groups measured in this study, the three selected schools within this district were more proportionately representative of African American (31.0%), White (25.74%), and Hispanic (24.06%) students. Approximately 51.2% of the overall student population was recorded as economically disadvantaged.

The overall sample was proportionately representative of African American (31.5%), White (29.4 %), and Hispanic (39.1 %) males. Of the participants representing the first district ( $n = 66$ ), 24.2% were African American, 19.7% were White, and 56.1% were Hispanic. Of the participants representing the second district ( $n = 80$ ), 35.0% were African American, 40.0% were White, and 25.0% were Hispanic. Of the participants representing the third district ( $n = 51$ ), 35.3% were African American, 25.5% were White, and 39.2% were Hispanic.

### Procedures

Participants of the elementary schools were tested individually during their music class time in a private area in order to minimize possible distractions. Grade 6 subjects who were in the suburban middle school were tested during their fine arts elective time period whereas the participants in the urban middle school were tested during their health/physical education elective class time. Most participants were recorded during the morning time between the hours of 8 a.m. and 12:30 p.m. because of the specials/electives schedule. Participants from the large urban middle school were recorded between the hours of 10:30 a.m. to 3:00 p.m. Each

participant recorded the vocal exercises individually with me in order to avoid any concerns of group-related embarrassment. Because each school was unique, the location of the recording area for each school was different. Some participants were recorded in a vacant music classroom while some participants were recorded in private practice rooms, conference rooms, or vacant workrooms. Though these variables could not be controlled for, I made every attempt to arrange the recording equipment in the same way in each location and to secure as much privacy for the participants as possible. In addition, all locations had adequate space and lighting so as to be comfortable for the participants.

I informed prospective participants of the purpose of the study and the data collection methods. Students were also played an example recording of a student performing the vocal exercises used in the study. The student on this recording was a 6<sup>th</sup> grade male who attended a private school in the North Texas area. Students were also informed that if they participated in the study, their name would be placed in a drawing to possibly win an iPod Nano, 4 GB. After students had been informed of the study and an example of the vocal exercises had been played, interested male students were given a letter of consent/assent. Letters of consent were brought home with each subject in order to secure permission from their legal guardian. Spanish and English versions of the consent form were made available. Students were informed of the deadline for returning the signed forms to the music teacher. I strongly encouraged potential participants to return the signed form the next day, but forms were accepted until the recording day. A folder for filing completed consent/assent forms was left with the school's music/electives teacher. The consent/assent forms used in this study can be found in Appendix B.

Upon receiving consent, I reviewed the procedures for recording with each subject

individually. The participants rehearsed the vocal exercises with me on the day the participants were recorded. Each participant's date of birth and ethnicity were documented before the performance of the vocal exercises. This study used *glissandi*, a continuous slide between two notes, to assess each student's highest terminal pitch (HTP) and lowest terminal pitch (LTP). Students were instructed to begin on the lowest note they could phonate and slowly glide up to their highest note on the vowel "ah." They performed this exercise three times with the instruction to try to ascend higher with each attempt. The students then performed three descending *glissandi* from high to low with the instruction to try to sing lower with each attempt.

All participants were recorded using a MXL 990 condenser microphone, which was connected to an MBox2 (Digidesign). Participants were instructed to stand on a marker and the microphone stand was adjusted according to their height before beginning the vocal task. Each recording was digitally recorded using ProTools LE 7.1 and analyzed using Peak LE 5.2 on a MacBook Pro (2.2 GHz Intel Core 2 Duo, Apple™).

Each participant's recorded vocal task was digitally analyzed and the highest and lowest terminal pitches were used to estimate vocal range with the vocal range being all notes within the LTP and HTP. Highest terminal pitch was determined based on the highest pitch of the three *glissandi* attempts of each subject; however in some cases, participants actually sang higher when beginning the high to low *glissandi* exercise. In those few cases, the HTP was derived from the high to low exercise. Lowest terminal pitch was determined based on the lowest pitch of the three *glissandi* attempts of each subject. Any phonational gaps were noted in order to better determine the stage of the participant's voice change. For instance, phonational gaps present between G4 and C5 may indicate the emergence of the falsetto register which would indicate the male has progressed to Stage 3 or 4 of the voice change.

I opened each participant's 6 .wav files using Peak LE 5.2. Each .wav file represented one exercise. The digital tuner included in the GarageBand 4.1.1 software (Apple, Inc.) was used to determine the pitch names. As each .wav file was played, I carefully watched the digital tuner. In many cases, I would isolate a portion of the .wav file in order to determine the HTP or LTP. This process was used for each .wav file until an accurate HTP and LTP could be assigned. Session length from the study varied due to some students having a more extensive vocal range than others with the shortest session recorded at 45 seconds and the longest session recorded at 120 seconds.

Once the HTP and LTP were established, each participant was categorized into one of Cooksey's voice change stages. According to Cooksey (1999), the unchanged voice has a vocal range of A3 (LTP) to F5 (HTP). Stage 1 (Midvoice I) of the voice change marks the onset of the voice change (Cooksey, 1999, p. 14) and has a vocal range of G#3 (LTP) to C5 (HTP). Stage 2 (or Midvoice II) has a vocal range of F3 (LTP) to A4 (HTP) and is the stage in which the falsetto register emerges (Cooksey, 1999). Stage 3 (or Midvoice IIA) has a range of D3 (LTP) to F#4 (HTP), Stage 4 (or "New Voice") a range of B2 (LTP) to D#4 (HTP), and Stage 5 (or "Emerging Adult Voice") a range of G2 (LTP) to D4 (HTP).

### Research Design

The research questions for this study were: 1) What are the characteristics of the voice change in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade male students?; 2) What are the characteristics of the voice change in African American, White, and Hispanic male students?; 3) What are the characteristics of the voice change in male students of urban and suburban schools?; and 4) Do differences exist amongst African American, White, and Hispanic males in the age-of-onset of the male voice

change? Because this study compared possible differences between ethnic groups for Research Question 4, an ex post facto design was employed. Unlike an experimental study, an ex post facto design cannot manipulate the independent variable because it is a naturally occurring variable. Though an ex post facto design cannot imply causation, it can contribute to a better understanding of a phenomenon. Table 2 discusses possible threats to internal validity for this study.

Table 2

*Discussion of Threats to Internal Validity for This Study*

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Threat	Discussion of threat
Selection	Because groups could not be manipulated, certain variables could not be controlled for such as socioeconomic status and nutritional background, which may have accounted for possible differences between groups or may have counteracted the true impact of the independent variable itself.
Mortality	Because participants were only measured one time, there was no loss of participants in this study.
Location	Participants were measured at their individual schools, so the various testing environments from school to school did vary. Attempts were made to maintain the same set up for the recording equipment and procedures in order to minimize the effect of this threat, but location may have impacted the results of the study.
Implementation	All participants were measured and recruited by me in order to reduce the threat of implementation. I attempted to implement the same procedures for all participants; however an external review of these procedures was not conducted to verify consistent implementation.

*(table continues)*

Table 2 (*continued*).

Threat	Discussion of threat
Instrumentation	I personally analyzed the vocal exercises of each participant in order to determine HTP and LTP. In order to control for instrument decay, I measured a small amount at a time and also had an unbiased observer analyze the vocal exercises of each participant. Determining the pilot study participants' LTP was a difficult process because many of the participants descended too quickly and did not finish on a distinct sung pitch. Because of this, the main study participants were instructed to slowly descend and encouraged to hold their lowest pitch in order to allow for more accurate measurement.
Testing	Testing was not a concern because only one test (the vocal range measurement) was given and no treatment was implemented.
History	History threats will be documented if noted. Threats were potentially avoided by scheduling the measurements during a time period that contained no holidays or school testing interruptions. I also checked with the school administrator to see if any fire drills or other interruptions were expected. When any interruptions did occur (i.e., intercom announcements, school bell, etc.), the recording session was immediately stopped and any interrupted recording tracks were re-recorded.
Maturation	Maturation could not be controlled for in this study. I measured all participants in the time frame of one month in an attempt to limit this threat. The various age groups used in the study may have matured at different rates over the course of the study.
Attitude	Attitude may have been a concern in that some participants may have had a greater or lesser motivation to perform the required vocal exercises.
Regression	Regression was not a concern in this study because groups were pre-selected based on ethnicity and not on high or low scoring groups.

*(table continues)*

Table 2 (*continued*).

Threat	Discussion of threat
Statistical Conclusion	The statistical conclusion threat was lessened by documenting reliability of the vocal range measurement, using appropriate statistics, and considering effect size in addition to statistical significance.

### Data Analysis

In order to address Research Question 1, “What are the characteristics of the voice change in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade male students,” descriptive statistics including ranges, means, and standard deviations were calculated for age (in days), highest terminal pitch (HTP), and lowest terminal pitch (LTP) of each grade level. Also reported was the number of 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade participants classified in each stage of the voice change. Age was determined by the participant’s date of birth up to the date he was recorded performing the vocal exercise. To address Research Question 2, “What are the characteristics of the voice change African American, White, and Hispanic male students,” descriptive statistics including ranges, means, and standard deviations were calculated for age, HTP, and LTP of each ethnic group. Also reported was the number of African American, White, and Hispanic participants classified in each stage of the voice change. To address Research Question 3, “What are the characteristics of the voice change in male students of urban and suburban schools,” descriptive statistics including ranges, means, and standard deviations were calculated for age, HTP, and LTP of each school type. Also reported was the number of urban and suburban school participants classified in each stage of the voice change. To address Research Question 4, “Do differences exist amongst African American,



White, and Hispanic males in the age-of-onset of the male voice change,” a one-way, between-subjects ANOVA was conducted using only those subjects in Stage 1 of the voice change.

Ethnicity served as the independent variable and the age-of-onset of the voice change served as the dependent variable. An alpha level of .05 with a non-directional hypothesis was established for this analysis.

### Validity and Reliability

Validity was initially addressed by reviewing the pertinent literature concerning the methods used to measure vocal range of elementary children. From this reviewed literature the procedures for the current study were established. Previous studies of the male voice change have measured vocal ranges by having participants match piano pitches in a particular pattern or sequence similar to vocal warm-ups in choral rehearsal settings (Barresi & Bless, 1984; Cooksey et al., 1984; Groom, 1984; Killian, 1999; Killian & Moore, 1997; Rutkowski, 1984). Other studies measuring vocal range in children have also used a stimulus tone, which participants had to match (Hollien, Green, & Massey, 1994; Moore, 1991; Wassum, 1979). While this method of measuring the voice range is commonly practiced, matching a stimulus tone can create problems for male adolescent singers in which pitch-matching difficulties may become more prevalent (Collins, 1999; Cooksey, 1999; Willis & Kenny, in press). For instance, a male student who has difficulty matching pitch may perform the vocal exercises with monotone singing. Measuring the HTP and LTP of a monotone singer results in small vocal range even though that singer may actually be able to sing much higher and/or lower. These possible pitch-matching problems could present measurement error of accurate vocal range, which could cause a misclassification of the voice change stage. Killian (1999) noted that of the 99 participants tested in her study, “20 had

mild to severe problems matching pitch” (p. 366). Karr (1988) also encountered this problem and was forced to adjust his vocal range measurement procedures for those participants who could not match pitch. Because of this concern, the vocal range procedures used in this study were modeled after those used in Willis and Kenny (in press) that utilized *glissandi* without a stimulus tone.

Willis and Kenny (in press) employed the *glissandi* exercises in a longitudinal study, which examined the relationship between weight, speaking fundamental frequency, and phonational gaps in the changing male voice. The study measured 18 boys between the ages of 12.0 and 13.7 years over a 12-month period. The sample was reported to be ethnically diverse and reflective of Australian society. As in this study, Willis and Kenny had the participants perform three ascending *glissandi* with the instruction to go as high as possible and three descending *glissandi* with instruction to go as low as possible all on the vowel “ah.” Karr (1988) employed these *glissandi* exercises to measure vocal range when he encountered participants who could not match pitch. Baken and Orlikoff (2000) wrote that a broad sweep across the vocal range, as is done with the *glissandi* exercises, may produce a more accurate estimate of vocal range. The “ah” vowel has also been used in other research studies in order to measure vocal range (Barresi & Bless, 1984; Groom, 1984; Harris, 1996; Hollien, Green, & Massey, 1994; Hook, 2005; Karr, 1988; Rutkowski, 1984). The participants in the Willis and Kenny study stood while recording in order to assist with breath support. Results indicated that phonational gaps were associated with weight gain and that phonational gaps were more prevalent later in puberty.

Content validity was assessed using a content validity panel that consisted of a male conductor/director of a prominent children’s community choral program in New York City with

10 years of experience in working with children and adolescent choirs, a female elementary music coordinator of a large public school district in North Texas with 15 years of experience in working with elementary and middle school choirs, and a female university music professor with 10 years of experience in working with children's choirs in the Southeast Tennessee region. The panel reviewed the procedures for measuring the vocal range of each subject. Upon reviewing these procedures, the panel was asked to respond to several questions I posed. Such questions concerned the clarity and order of the procedures, the number of performances of each *glissando* exercise, the process for determining the HTP and LTP, the most appropriate vowel to use for the vocal exercises, and any other recommendations or concerns the panel might have. One panelist recommended the use of the "oo" vowel for performing the *glissandi* exercises; however, the other two panelists stated that the "ah" vowel promoted a more open sound that would be appropriate in establishing both high and low pitches. Also, based on the input of the validity panel, a vocal model was recorded as a demonstration of the vocal exercises for the subjects and the procedure was added of rehearsing with the participants so each participant was more comfortable with the exercises before recording.

After the recommendations of the content validity panel, the adjusted procedures were field-tested with 3 4<sup>th</sup> grade male students (one African American, one White, and one Hispanic), 3 5<sup>th</sup> grade male students (one African American, one White, and one Hispanic) during their specials class time at a suburban public school in the North Texas region, and 3 6<sup>th</sup> grade students from a suburban private school during their specials class time (one African American, one White, and one Hispanic). Neither of the schools in which the field test took place was used in the pilot or main study. All students were informed of the procedures to be used in order to estimate voice range. Students were asked if they understood the procedures, if they thought

they could easily perform the vocal tasks, if they would be too embarrassed to perform the vocal tasks in front of a researcher, and if they felt students their age group would be able to perform the vocal exercises. Students expressed that they would not feel embarrassed to perform the vocal tasks, but did confess they would not have known what a *glissando* was without a vocal demonstration. Students agreed with the content validity panel recommendation for the need of a vocal model to be played to the participants before performing the exercises. The recorded vocal model was not played for the field-tested students because the recording was not completed in time; however, I modeled the exercises for the students. The students remarked that they felt participants their age would easily understand the procedures after hearing a vocal demonstration and many spontaneously performed the vocal tasks discussed. Based on the reviewed literature, the content validity panel's recommendations, and the field test, the method for estimating subjects' ranges was established.

After establishing the procedures, a pilot study was conducted. The pilot study sample ( $n = 29$ ) consisted of 4<sup>th</sup> grade ( $n = 10$ ), 5<sup>th</sup> grade ( $n = 15$ ), and 6<sup>th</sup> grade ( $n = 4$ ) male students from two elementary schools and one middle school located in a large suburban public school district in the North Texas region. All 4<sup>th</sup> and 5<sup>th</sup> grade participants were in elementary general music class. All 6<sup>th</sup> grade participants were members of their school choir. According to the 2006-2007 AEIS report, the district reported total enrollment of 19,661 students and employed approximately 1,930 teachers in 30 schools. In Grades 4-6, the student population was approximately 4,592. The following ethnicities were represented in the overall student population: African American (12.2%), White (55.3%), Hispanic (29.5%), Native American (0.7%), and Asian (2.3%). Though the overall district demographics may not have been proportionately representative of the three ethnic groups measured in this study, the schools

selected from this district were representative of African American, White, and Hispanic students. Approximately 38.0% of the overall student population was recorded as economically disadvantaged. The three ethnic groups represented in the pilot study were: White ( $n = 12$ ), African American ( $n = 9$ ), and Hispanic ( $n = 8$ ). Table 3 displays the number of number of subjects in each ethnic group by grade level.

Table 3

*Pilot Study Ethnic Group Representation by Grade*

Ethnic Group	4 <sup>th</sup> grade	5 <sup>th</sup> grade	6 <sup>th</sup> grade
African American	3	4	2
White	4	7	1
Hispanic	3	4	1
Total	10	15	4

To assess the reliability of the vocal range test, myself and another graduate student from a large university in North Texas independently documented the HTP and LTP by listening to each digital voice track through Peak LE 5.2. We then used a digital tuner from the GarageBand 4.1.1 software (Apple, Inc.) to determine the HTP and LTP. Pitch names were converted to frequencies in hertz in order to calculate intervallic descriptive data. Interjudge reliability was calculated by dividing agreements by agreements plus disagreements. Percentages of agreement between the two observers were calculated from the pilot study (HTP= 93%; LTP= 90%).

After establishing the subjects' vocal ranges (LTP to HTP), each subject was coded based on Cooksey's stages of the voice change. If the subject's voice was unchanged, he was coded as

“0.” Stage 1 of the voice change was coded as “1” and represented the onset of the male voice change. Stages 2, 3, 4, and 5 were coded as “2,” “3,” “4,” and “5” respectively.

## CHAPTER 4

### RESULTS

The results from the study are presented in this section. The research questions were: 1) What are the characteristics of the voice change in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade male students? 2) What are the characteristics of the voice change in African American, White, and Hispanic male students? 3) What are the characteristics of the voice change in students of suburban and urban schools? 4) Do differences exist amongst African American, White, and Hispanic males in the age-of-onset of the male voice change? Questions 1 through 3 were answered using descriptive statistics of range, mean, and standard deviation. In order to answer Question 4, data were analyzed using a between-subjects, one-way ANOVA.

#### Research Questions

##### *Research Question 1*

Research Question 1 sought to describe the characteristics of the voice change in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade males. Overall means and standard deviations were calculated for the age, highest terminal pitch (HTP), and lowest terminal pitch (LTP) for the 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade participants ( $n = 197$ ). Participants' ages ranged from 3547.00 days old (approximately 9.72 years old) to 5013.00 days old (approximately 13.73 years old) ( $M = 4175.44$ ,  $SD = 332.46$ ). HTP ranged from 246.94 Hz (B3) to 1108.73 Hz (C#6) ( $M = 559.94$ ,  $SD = 160.05$ ) and LTP ranged from 92.50 Hz (F#2) to 261.63 Hz (C4) ( $M = 189.29$ ,  $SD = 30.16$ ).

Each participant was classified according to Cooksey's voice change classification system. Overall results revealed that 82 participants (41.62%) were classified as unchanged voices, 54 participants (27.41%) were classified in Stage 1, 38 participants (19.29%) were

classified in Stage 2, 15 participants (7.61%) were classified in Stage 3, 4 participants (2.03%) were classified in Stage 4, and 4 participants (2.03%) were classified in Stage 5 of the voice change, with the largest number of participants classified as unchanged voices followed by Stage 1 and then Stage 2 of the voice change. Table 4 presents the means and standard deviations for age, HTP, and LTP by voice change stage. The mean age is higher for each successive voice change stage with the exception of the unchanged voice to Stage 1. The mean HTP and LTP decrease with each successive voice change stage.

Table 4

*Descriptive Statistics for Age, HTP, and LTP by Voice Change Stage*

Variables	Voice Change Stages					
	0 <i>n</i> = 82	1 <i>n</i> = 54	2 <i>n</i> = 38	3 <i>n</i> = 15	4 <i>n</i> = 4	5 <i>n</i> = 4
Mean Age	4121.56 (322.85)	4089.81 (303.10)	4234.55 (336.36)	4439.20 (237.40)	4542.50 (265.58)	4518.50 (339.02)
Mean HTP	713.82 (96.53)	528.28 (48.98)	410.20 (43.18)	351.77 (29.60)	325.84 (29.43)	270.30 (26.98)
Mean LTP	204.70 (21.32)	196.86 (18.06)	178.34 (18.97)	150.09 (17.13)	115.09 (8.19)	96.62 (2.75)

*Note.* Numbers in parentheses denote standard deviations.

Grade 4 participants' (*n* = 61) ages ranged from 3547.00 days old (approximately 9.72 years old) to 4261.00 days old (approximately 11.67 years old) (*M* = 3825.23, *SD* = 162.63). HTP ranged from 349.23 Hz (F4) to 1108.73 Hz (C#6) (*M* = 611.53, *SD* = 144.62) and LTP ranged from 138.59 Hz (C#3) to 261.63 Hz (C4) (*M* = 201.44, *SD* = 21.20). Results for the 4<sup>th</sup>



grade participants revealed that 33 participants (54.10%) were classified as unchanged voices, 19 participants (31.15%) were classified in Stage 1, 7 participants (11.48%) were classified in Stage 2, and 2 participants (3.28%) were classified in Stage 3 of the voice change with the largest percentage of 4<sup>th</sup> grade participants being classified as unchanged voices followed by Stage 1 and then Stage 2 of the voice change. Of the 4<sup>th</sup> grade participants, 45.90% were classified as changing voices.

Grade 5 participants' ( $n = 73$ ) ages ranged from 3856.00 days old (approximately 10.56 years old) to 4608.00 days old (approximately 12.62 years old) ( $M = 4145.01$ ,  $SD = 160.48$ ). HTP ranged from 293.67 Hz (D4) to 932.33 Hz (A#5) ( $M = 556.99$ ,  $SD = 156.42$ ) and LTP ranged from 98.00 Hz (G2) to 246.94 Hz (B3) ( $M = 191.87$ ,  $SD = 21.20$ ). Results for the 5<sup>th</sup> grade participants revealed that 28 participants (38.36%) were classified as unchanged voices, 24 participants (32.88%) were classified in Stage 1, 15 participants (20.55%) were classified in Stage 2, 4 participants (5.48%) were classified in Stage 3, 1 participant (1.37%) was classified in Stage 4, and 1 participant (1.37%) was classified in Stage 5 of the voice change, with the most number of 5<sup>th</sup> grade participants being classified as unchanged voices followed by Stage 1 and then Stage 2 of the voice change. Of the 5<sup>th</sup> grade participants, 61.64% were classified as changing voices.

Grade 6 participants' ( $n = 63$ ) ages ranged from 4250.00 days old (approximately 11.64 years old) to 5013.00 days old (approximately 13.73 years old) ( $M = 4549.79$ ,  $SD = 172.48$ ). HTP ranged from 246.94 Hz (B3) to 830.61 Hz (G#5) ( $M = 513.42$ ,  $SD = 165.82$ ) and LTP ranged from 92.50 Hz (F#2) to 246.94 Hz (B3) ( $M = 174.55$ ,  $SD = 34.08$ ). Results for the 6<sup>th</sup> grade participants revealed that 21 participants (33.33%) were classified as unchanged voices, 11 participants (17.46%) were classified in Stage 1, 16 participants (25.40%) were classified in

Stage 2, 9 participants (14.28%) were classified in Stage 3, 3 participants (4.76%) were classified in Stage 4, and 3 participants (4.76%) were classified in Stage 5 of the voice change, with the most number of 6<sup>th</sup> grade participants being classified as unchanged voices followed by Stage 2 and then Stage 1 of the voice change. Of the 6<sup>th</sup> grade participants, 66.67% were classified as changing voices.

Table 5 presents the overall descriptive statistics for 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade participants. As shown in Figure 3, results indicate a steady decline of the mean HTP and LTP from 4<sup>th</sup> to 6<sup>th</sup> grade. Also, the percentages of unchanged voices reduced from 4<sup>th</sup> to 6<sup>th</sup> grade with the most drastic reduction found between 4<sup>th</sup> and 5<sup>th</sup> grade (-15.84%). Grades 4 and 5 contained a larger percentage of participants classified in Stage 1 (the onset of the voice change) than 6<sup>th</sup> grade; however, a larger percentage of 6<sup>th</sup> grade participants were in Stages 2, 3, 4, and 5 than 4<sup>th</sup> or 5<sup>th</sup> grade participants.

Table 5

*Overall Descriptive Statistics for 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> Grade Participants*

Variables	4 <sup>th</sup> Grade <i>n</i> = 61	5 <sup>th</sup> Grade <i>n</i> = 73	6 <sup>th</sup> Grade <i>n</i> = 63
Mean Age	3825.23 (162.63)	4145.01 (160.48)	4549.79 (172.48)
Mean HTP	611.53 (144.62)	556.99 (156.42)	513.42 (165.82)
Mean LTP	201.44 (21.20)	191.87 (21.20)	174.55 (34.08)

*(table continues)*

Table 5 (continued).

	4 <sup>th</sup> Grade	5 <sup>th</sup> Grade	6 <sup>th</sup> Grade
Variables	<i>n</i> = 61	<i>n</i> = 73	<i>n</i> = 63
Voice Change Stage			
<b>Unchanged</b>	<b>54.10%</b>	<b>38.36%</b>	<b>33.33%</b>
<b>Changing</b>	<b>45.90%</b>	<b>61.64%</b>	<b>66.67%</b>
1	31.15%	32.88%	17.46%
2	11.48%	20.55%	25.40%
3	3.28%	5.48%	14.28%
4	0.00%	1.37%	4.76%
5	0.00%	1.37%	4.76%

Note. Numbers in parentheses denote standard deviations.

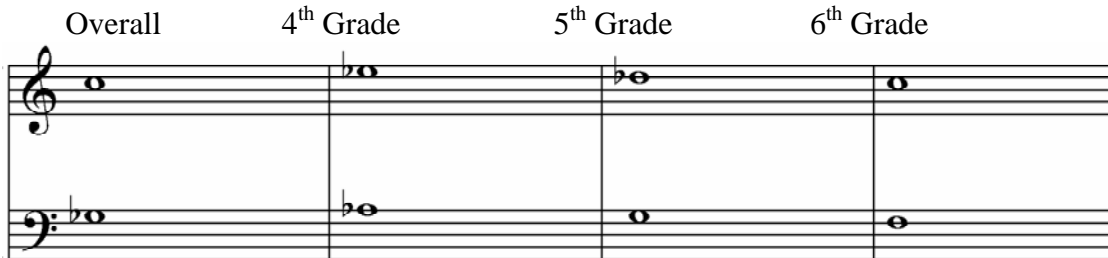


Figure 3. Approximate vocal ranges for 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade participants. [These vocal ranges were created from the mean HTP and LTP for each grade level. Because the mean HTP and LTP when converted from a pitch frequency to a pitch name do not fall on exact pitch names, the pitch name closest to the mean frequency was used.]

### Research Question 2

Research Question 2 sought to describe the characteristics of the voice change in African American, White, and Hispanic male students. Means and standard deviations were calculated for the age, highest terminal pitch (HTP), and lowest terminal pitch (LTP) for the African American participants (*n* = 62). The African American participants' ages ranged from 3591.00

days old (approximately 9.84 years old) to 4845.00 days old (approximately 13.27 years old) ( $M = 4138.77$ ,  $SD = 311.43$ ). HTP ranged from 277.18 Hz (C#4) to 880.00 Hz (A5) ( $M = 526.39$ ,  $SD = 154.57$ ) and LTP ranged from 116.54 Hz (A#2) to 246.94 Hz (B3) ( $M = 188.55$ ,  $SD = 26.06$ ). Results for the African American participants revealed that 19 participants (30.65%) were classified as unchanged voices, 20 participants (32.26%) were classified in Stage 1, 14 participants (22.58%) were classified in Stage 2, 8 participants (12.90%) were classified in Stage 3, and 1 participant (1.61%) was classified in Stage 4 of the voice change.

Means and standard deviations were calculated for the age, HTP, and LTP for the White participants ( $n = 58$ ). The White participants' ages ranged from 3547.00 days old (approximately 9.72 years old) to 4983.00 days old (approximately 13.65 years old) ( $M = 4148.67$ ,  $SD = 361.95$ ). HTP ranged from 311.13 Hz (D#4) to 1108.73 Hz (C#6) ( $M = 608.32$ ,  $SD = 143.16$ ) and LTP ranged from 103.83 Hz (G#2) to 261.63 Hz (C4) ( $M = 194.81$ ,  $SD = 29.04$ ). Results for the White participants revealed that 30 participants (51.72%) were classified as unchanged voices, 17 participants (29.31%) were classified in Stage 1, 9 participants (15.52%) were classified in Stage 2, 1 participant (1.72%) was classified in Stage 3, and 1 participant (1.72%) was classified in Stage 4 of the voice change.

Means and standard deviations were calculated for the age, HTP, and LTP for the Hispanic participants ( $n = 77$ ). The Hispanic participants' ages ranged from 3567.00 days old (approximately 9.77 years old) to 5013.00 days old (approximately 13.73 years old) ( $M = 4225.13$ ,  $SD = 323.73$ ). HTP ranged from 246.94 Hz (B3) to 932.33 Hz (A#5) ( $M = 550.52$ ,  $SD = 169.47$ ) and LTP ranged from 92.50 Hz (F#2) to 246.94 Hz (B3) ( $M = 185.74$ ,  $SD = 33.64$ ). Results for the Hispanic participants revealed that 33 participants (42.86%) were classified as unchanged voices, 17 participants (22.08%) were classified in Stage 1, 15 participants (19.48%)

were classified in Stage 2, 6 participants (7.79%) were classified in Stage 3, 2 participants (2.60%) were classified in Stage 4, and 4 participants (5.19%) were classified in Stage 5 of the voice change.

Table 6 presents the overall descriptive statistics for African American, White, and Hispanic participants. The highest mean HTP was found in the White participants followed by the Hispanic participants and then the African American participants. The highest mean LTP was found in the White participants followed by the African American participants and then the Hispanic participants. The largest percentage of unchanged voices was found in the White participants followed by the Hispanic participants and then the African American participants. The African American participants had higher percentages in Stage 1, Stage 2, and Stage 3 of the voice change than the White and Hispanic participants; however, the Hispanic participants had higher percentages in Stage 4 and 5 than the African American and White participants.

Table 6

*Overall Descriptive Statistics for African American, White, and Hispanic Participants*

Variables	<u>African American</u> <i>n</i> = 62	<u>White</u> <i>n</i> = 58	<u>Hispanic</u> <i>n</i> = 77
Mean Age	4138.77 (311.43)	4148.67 (361.95)	4225.13 (323.73)
Mean HTP	526.39 (154.57)	608.32 (143.16)	550.52 (169.47)
Mean LTP	188.55 (26.06)	194.81 (29.04)	185.74 (33.64)

*(table continues)*

Table 6 (continued).

Variables	<u>African American</u> <i>n</i> = 62	<u>White</u> <i>n</i> = 58	<u>Hispanic</u> <i>n</i> = 77
Voice Change Stage			
<b>Unchanged</b>	<b>30.65%</b>	<b>51.72%</b>	<b>42.86%</b>
<b>Changing</b>	<b>69.35%</b>	<b>48.28%</b>	<b>57.14%</b>
1	32.26%	29.31%	22.08%
2	22.58%	15.52%	19.48%
3	12.90%	1.72%	7.79%
4	1.61%	1.72%	2.59%
5	0.00%	0.00%	5.19%

*Note.* Numbers in parentheses denote standard deviations.

Table 7 presents descriptive statistics for 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade African American, White, and Hispanic participants. Larger percentages of 4<sup>th</sup> and 5<sup>th</sup> grade African American participants were classified as changing voices than both White and Hispanic participants. In addition, there was a greater percentage of 4<sup>th</sup> grade African American participants in Stages 1, 2, and 3 of the voice change than White and Hispanic participants. Though larger percentages of 5<sup>th</sup> grade White participants were classified in Stage 1 of the voice change, African American participants had larger percentages classified in Stages 2 and 3 of the voice change than White and Hispanic participants. One 5<sup>th</sup> grade White participant was classified in Stage 4 of the voice change and one Hispanic participant was classified in Stage 5 of the voice change.

Results for the 6<sup>th</sup> grade participants revealed that Hispanic participants had the largest percentage of changing voices followed closely by African American participants and then

White participants. Of the 6<sup>th</sup> grade White participants classified as changing voices, most were classified in the early stages of the voice change whereas the African American participants had a larger percentage classified in Stages 3 and 4. Hispanic 6<sup>th</sup> grade participants had larger percentages in the more advanced stages of the voice change than White and African American participants with 3 Hispanic participants classified in Stage 5 of the voice change.

Figure 4 displays the approximate vocal ranges for 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade African American, White, and Hispanic participants. Of the 4<sup>th</sup> grade participants, the White participants had a higher mean HTP than the African American and Hispanic participants with each group separated by a few semitones. The mean LTPs were very similar. The 5<sup>th</sup> grade overall vocal ranges were very similar for each ethnic group; however the 6<sup>th</sup> grade vocal ranges revealed a higher mean HTP and LTP for White participants followed by African American and then Hispanic participants.

Table 7

*Descriptive Statistics for 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> Grade Participants by Ethnicity*

Variables	4 <sup>th</sup> Grade			5 <sup>th</sup> Grade			6 <sup>th</sup> Grade		
	AA <i>n</i> = 17	Wh <i>n</i> = 25	Hsp <i>n</i> = 19	AA <i>n</i> = 30	Wh <i>n</i> = 12	Hsp <i>n</i> = 31	AA <i>n</i> = 15	Wh <i>n</i> = 21	Hsp <i>n</i> = 27
Mean Age	3820.06 (194.69)	3805.88 (136.96)	3855.32 (167.22)	4123.30 (169.26)	4146.25 (136.28)	4165.55 (162.48)	4530.93 (176.92)	4558.14 (133.05)	4553.78 (200.47)
Mean HTP	556.40 (154.57)	651.72 (143.16)	607.97 (169.47)	528.34 (158.51)	574.71 (135.26)	577.86 (133.65)	488.47 (164.35)	575.85 (138.13)	478.71 (177.73)
Mean LTP	193.29 (21.59)	208.21 (21.74)	199.81 (18.01)	192.97 (20.79)	182.74 (41.94)	194.33 (27.71)	174.32 (35.29)	185.76 (21.70)	165.97 (39.49)
Voice Change Stage									
<b>Unchanged</b>	<b>35.30%</b>	<b>64.00%</b>	<b>57.89%</b>	<b>30.00%</b>	<b>33.33%</b>	<b>48.93%</b>	<b>26.67%</b>	<b>47.62%</b>	<b>25.93%</b>
<b>Changing</b>	<b>64.70%</b>	<b>36.00%</b>	<b>42.11%</b>	<b>70.00%</b>	<b>66.67%</b>	<b>51.07%</b>	<b>73.33%</b>	<b>52.38%</b>	<b>74.07%</b>
1	35.29%	32.00%	26.32%	36.67%	41.67%	25.81%	20.00%	19.05%	14.81%

*(table continues)*

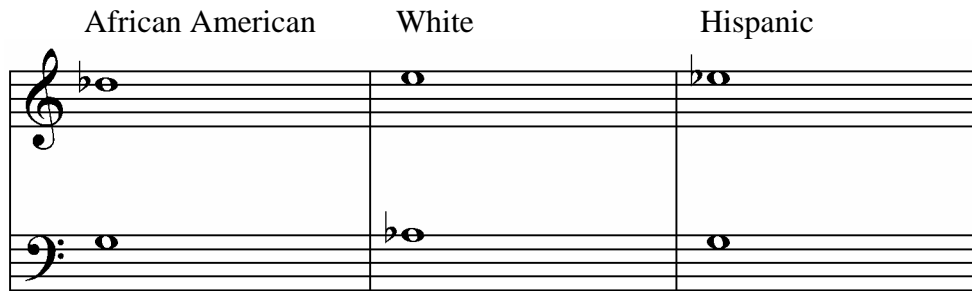


Table 7 (continued).

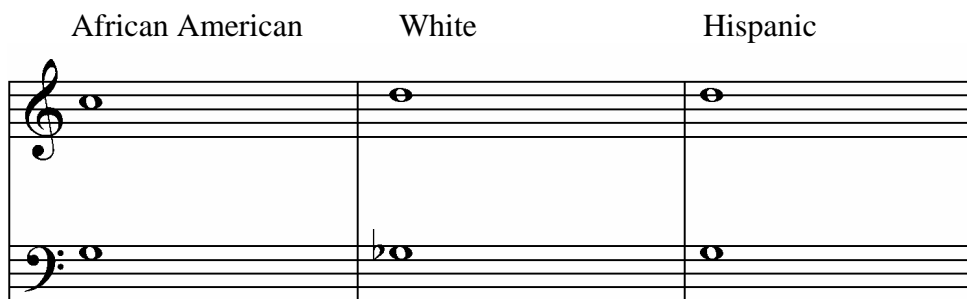
Variables	4 <sup>th</sup> Grade			5 <sup>th</sup> Grade			6 <sup>th</sup> Grade		
	AA <i>n</i> = 17	Wh <i>n</i> = 25	Hsp <i>n</i> = 19	AA <i>n</i> = 30	Wh <i>n</i> = 12	Hsp <i>n</i> = 31	AA <i>n</i> = 15	Wh <i>n</i> = 21	Hsp <i>n</i> = 27
Voice Change Stage									
2	17.65%	4.00%	15.79%	23.33%	16.67%	19.35%	26.67%	28.57%	22.22%
3	11.76%	0.00%	0.00%	10.00%	0.00%	3.23%	20.00%	4.76%	18.51%
4	0.00%	0.00%	0.00%	0.00%	8.33%	0.00%	6.67%	0.00%	7.41%
5	0.00%	0.00%	0.00%	0.00%	0.00%	3.23%	0.00%	0.00%	11.11%

Notes. Numbers in parenthesis denote standard deviations. AA = African American, Wh = White, and Hsp = Hispanic.

4<sup>th</sup> Grade:



5<sup>th</sup> Grade:



6<sup>th</sup> Grade:

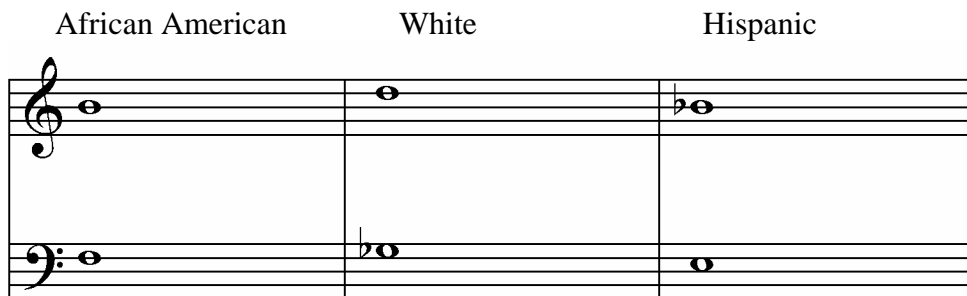


Figure 4. Approximate vocal ranges for 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade African American, White, and Hispanic participants. [These vocal ranges were created from the mean HTP and LTP for each grade level. Because the mean HTP and LTP when converted from a pitch frequency to a pitch name do not fall on exact pitch names, the pitch name closest to the mean frequency was used.]

### Research Question 3

Research Question 3 sought to describe the characteristics of the male voice change in urban and suburban school students. Means and standard deviations were calculated for the age,

HTP, and LTP for urban school male participants ( $n = 66$ ). The urban school participants' ages ranged from 3815.00 days old (approximately 10.45 years old) to 5013.00 days old (approximately 13.73 years old) ( $M = 4331.36$ ,  $SD = 361.68$ ). HTP ranged from 246.94 Hz (B3) to 932.33 Hz (A#5) ( $M = 523.27$ ,  $SD = 165.23$ ) and LTP ranged from 98.00 Hz (G2) to 246.94 Hz (B3) ( $M = 184.04$ ,  $SD = 29.72$ ). Overall results for the urban school participants revealed that 21 participants (31.82%) were classified as unchanged voices, 16 participants (24.24%) were classified in Stage 1, 18 participants (27.27%) were classified in Stage 2, 8 participants (12.12%) were classified in Stage 3, 2 participants (3.03%) were classified in Stage 4, and 1 participant (1.52%) was classified in Stage 5 of the voice change.

Means and standard deviations were calculated for the age, HTP, and LTP for suburban school male participants ( $n = 131$ ). The suburban school participants' ages ranged from 3547.00 days old (approximately 9.72 years old) to 4750.00 days old (approximately 13.01 years old) ( $M = 4096.89$ ,  $SD = 287.53$ ). HTP ranged from 246.94 Hz (B3) to 1108.73 Hz (C#6) ( $M = 578.42$ ,  $SD = 154.73$ ) and LTP ranged from 92.50 Hz (F#2) to 261.63 Hz (C4) ( $M = 191.94$ ,  $SD = 30.15$ ). Overall results for the suburban school participants revealed that 61 participants (46.56%) were classified as unchanged voices, 38 participants (29.01%) were classified in Stage 1, 20 participants (15.27%) were classified in Stage 2, 7 participants (5.34%) were classified in Stage 3, 2 participants (1.53%) were classified in Stage 4, and 3 participants (2.29%) was classified in Stage 5 of the voice change.

Table 8 displays descriptive information for urban and suburban school participants by grade. As Figure 5 reveals, the 4<sup>th</sup> and 5<sup>th</sup> grade suburban participants had slightly higher mean HTPs than the urban 4<sup>th</sup> and 5<sup>th</sup> grade participants. The 4<sup>th</sup> grade suburban participants had a slightly higher LTP than the urban 4<sup>th</sup> grade participants. The approximate vocal ranges for the

6<sup>th</sup> grade urban and suburban participants were similar. A larger percentage of 4<sup>th</sup> grade urban participants were classified as changing voices than 4<sup>th</sup> grade suburban participants.

Table 8

*Descriptive Statistics for Urban and Suburban School Participants by Grade*

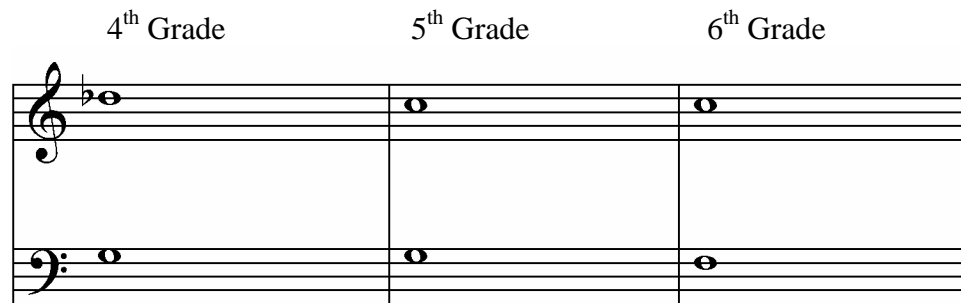
Variables	<u>4<sup>th</sup> grade</u>		<u>5<sup>th</sup> grade</u>		<u>6<sup>th</sup> grade</u>	
	Urban <i>n</i> = 12	Suburban <i>n</i> = 49	Urban <i>n</i> = 16	Suburban <i>n</i> = 57	Urban <i>n</i> = 38	Suburban <i>n</i> = 25
Mean Age	3797.75 (177.77)	3831.96 (159.95)	4130.94 (150.62)	4148.96 (164.20)	4584.26 (189.03)	4497.40 (130.03)
Mean HTP	553.26 (152.34)	625.80 (140.60)	524.94 (184.21)	565.99 (148.30)	513.10 (164.03)	513.89 (171.90)
Mean LTP	196.29 (22.18)	202.70 (20.99)	192.55 (17.65)	191.68 (30.31)	176.58 (33.79)	171.47 (34.99)
Voice Change Stage						
<b>Unchanged</b>	<b>33.33%</b>	<b>59.18%</b>	<b>31.25%</b>	<b>40.35%</b>	<b>31.58%</b>	<b>36.00%</b>
<b>Changing</b>	<b>66.67%</b>	<b>40.82%</b>	<b>68.75%</b>	<b>59.65%</b>	<b>68.42%</b>	<b>64.00%</b>
1	33.33%	30.61%	31.25%	33.33%	18.42%	16.00%
2	25.00%	8.16%	37.50%	15.79%	23.68%	28.00%
3	8.33%	2.04%	0.00%	7.02%	18.42%	8.00%
4	0.00%	0.00%	0.00%	1.75%	5.26%	4.00%
5	0.00%	0.00%	0.00%	1.75%	2.63%	8.00%

*Note.* Numbers in parentheses denote standard deviations.

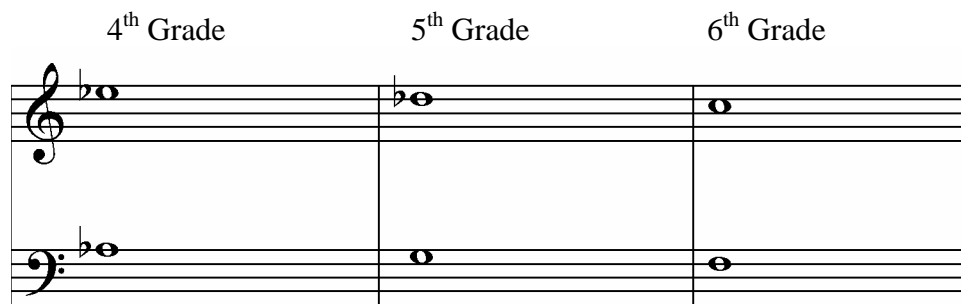
Also, a greater percentage of 4<sup>th</sup> grade urban participants were classified in Stage 2 of the voice change than suburban participants. A larger percentage of 5<sup>th</sup> grade urban participants were

classified as changing voices than 5<sup>th</sup> grade suburban participants. While a greater percentage of 5<sup>th</sup> grade urban participants were classified in Stage 2 of the voice change than suburban participants, 5<sup>th</sup> grade suburban participants had larger percentages of participants in Stages 3, 4, and 5 of the voice change. Results for the 6<sup>th</sup> grade urban and suburban participants were similar overall.

Urban:



Suburban:



*Figure 5.* Approximate vocal ranges for urban and suburban participants by grade. [These vocal ranges were created from the mean HTP and LTP for each grade level. Because the mean HTP and LTP when converted from a pitch frequency to a pitch name do not fall on exact pitch names, the pitch name closest to the mean frequency was used.]

Table 9 shows descriptive information for urban and suburban school participants by ethnicity. As Figure 6 reveals, the African American, White, and Hispanic suburban participants had slightly higher mean HTPs than the urban African American, White, and Hispanic participants. The African American suburban participants had a slightly higher LTP than the urban African American participants. Results revealed a larger percentage of urban participants

were classified as changing voices than suburban participants for each ethnicity. African American urban participants had a great percentage of participants classified in Stages 2, 3, and 4 than suburban African American participants. The same was evident for White urban participants. Hispanic urban participants had greater percentages of participants classified in Stages 2, 3, and 4 than suburban Hispanic participants; however, suburban Hispanic participants had larger percentages of participants in Stages 1 and 5.

Table 9

*Descriptive Statistics for Urban and Suburban School Participants by Ethnicity*

Variables	African American		White		Hispanic	
	Urban <i>n</i> = 16	Suburban <i>n</i> = 46	Urban <i>n</i> = 13	Suburban <i>n</i> = 45	Urban <i>n</i> = 37	Suburban <i>n</i> = 40
Mean Age	4252.56 (363.91)	4099.20 (284.82)	4462.54 (332.82)	4058.00 (319.35)	4319.35 (367.37)	4137.98 (251.87)
Mean HTP	470.61 (146.85)	545.79 (153.97)	591.98 (124.80)	613.03 (149.00)	521.91 (179.38)	576.99 (157.37)
Mean LTP	174.59 (28.52)	193.40 (23.58)	191.18 (21.02)	195.86 (31.09)	185.61 (32.37)	185.86 (35.19)
Voice Change Stage						
<b>Unchanged</b>	<b>12.50%</b>	<b>36.96%</b>	<b>46.15%</b>	<b>53.33%</b>	<b>35.14%</b>	<b>50.00%</b>
<b>Changing</b>	<b>87.50%</b>	<b>63.04%</b>	<b>53.85%</b>	<b>46.67%</b>	<b>64.86%</b>	<b>50.00%</b>
1	31.25%	32.61%	30.77%	28.89%	18.92%	25.00%
2	31.25%	19.57%	23.08%	13.33%	27.03%	12.50%
3	25.00%	8.70%	0.00%	2.22%	10.81%	5.00%

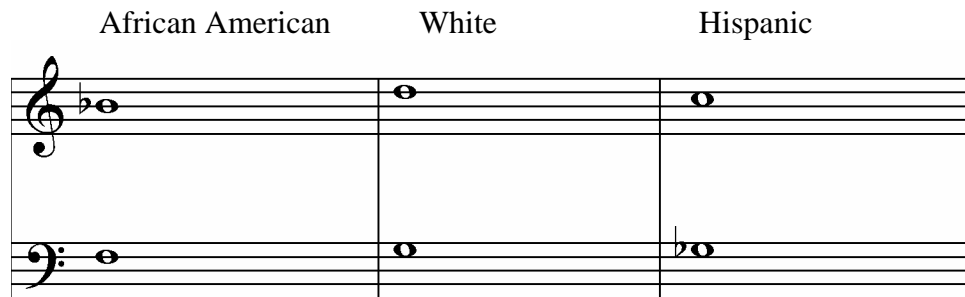
*(table continues)*

Table 9 (continued).

Variables	African American		White		Hispanic	
	Urban <i>n</i> = 16	Suburban <i>n</i> = 46	Urban <i>n</i> = 13	Suburban <i>n</i> = 45	Urban <i>n</i> = 37	Suburban <i>n</i> = 40
Voice Change Stage						
4	0.00%	2.17%	0.00%	0.00%	5.41%	0.00%
5	0.00%	0.00%	0.00%	2.22%	2.70%	7.50%

Note. Numbers in parentheses denote standard deviations.

Urban:



Suburban:

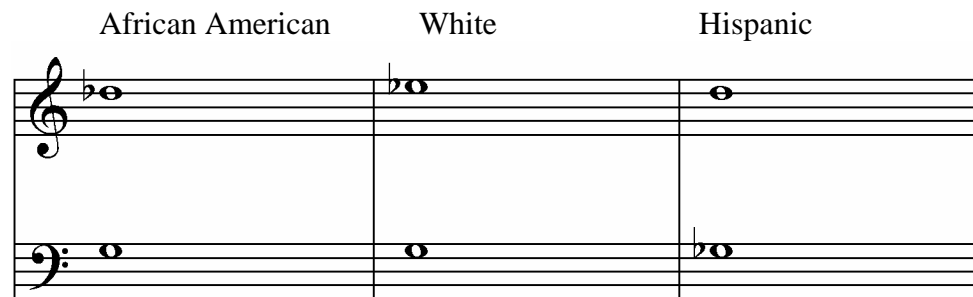


Figure 6. Approximate vocal ranges for urban and suburban participants by ethnicity. [These vocal ranges were created from the mean HTP and LTP for each grade level. Because the mean HTP and LTP when converted from a pitch frequency to a pitch name do not fall on exact pitch names, the pitch name closest to the mean frequency was used.]

#### *Research Question 4*

Question 4 sought to compare African American, White, and Hispanic students on the age-of-onset of the male voice change. In order to determine the effect of ethnicity on the age-of-onset of the male voice change (Stage 1 of the voice change), a one-way, between-subjects ANOVA was used with ethnicity (1 = African American,  $n = 20$ ; 2 = White,  $n = 17$ ; 3 = Hispanic,  $n = 17$ ) as the independent variable and age-of-onset (in days) as the dependent variable. The overall group means for the age-of-onset were calculated for African American participants ( $M = 4106.40$ ,  $SD = 311.73$ ), White participants ( $M = 4034.65$ ,  $SD = 325.06$ ), and Hispanic participants ( $M = 4125.47$ ,  $SD = 279.85$ ). Before performing the analysis, assumptions for normality and homogeneity of variance were checked.

Assumptions for normality were met for group 1 (African American) ( $skewness = .75$ ,  $CI \pm 1.00$ ;  $kurtosis = .10$ ,  $CI \pm 1.94$ ), group 2 (White) ( $skewness = .43$ ,  $CI \pm 1.08$ ;  $kurtosis = -1.06$ ,  $CI \pm 2.08$ ), and group 3 (Hispanic) ( $skewness = .43$ ,  $CI \pm 1.08$ ;  $kurtosis = -.70$ ,  $CI \pm 2.08$ ) using the 95% confidence interval multiplied by the standard error of skewness or kurtosis. The homogeneity of variance assumption was calculated using Levene's statistic ( $L = .30$ ,  $p = .74$ ), and the assumption was met for Groups 1, 2, and 3 – African American, White, and Hispanic. The overall mean age for participants in Stage 1 of the voice change was 4089.81 days old ( $SD = 303.10$ ) (approximately 11.20 years old) with ages ranging from 3614.00 to 4845.00 days old. African American participants' ages ranged from 3722.00 to 4845.00 days old ( $M = 4106.40$  [approximately 11.25 years old],  $SD = 311.73$ ), White participants' ages ranged from 3614.00 to 4593.00 days old ( $M = 4034.65$  [approximately 11.05 years old],  $SD = 325.06$ ), and Hispanic participants' ages ranged from 3689.00 to 4651.00 days old ( $M = 4125.47$  [approximately 11.30 years old],  $SD = 279.85$ ).



Results of the ANOVA revealed no significant main effect for ethnicity,  $F(2, 51) = .42, p = .66, \eta^2 = .02$ . Table 10 presents the ANOVA summary table. The effect size estimate,  $\eta^2$ , revealed that the independent variable, ethnicity, accounted for only 2% of the variance of the dependent variable, the age-of-onset of the voice change.

Table 10

*ANOVA Summary Table*

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Between Subjects	78853.23	2	39426.62	.420	.659
Within Subjects	4790090.90	51	93923.35		
Total	4868944.10	53			

## CHAPTER 5

### CONCLUSIONS AND RECOMMENDATIONS

One of the most challenging aspects of teaching adolescent music students involves the changing voice. While the female changing voice offers certain challenges for the vocal music educator, the demands associated with the male voice change are far greater (Cooksey, 1999). Research has shown that many music teachers are unprepared to properly train the adolescent male voice (Killian, 2003; Usher, 2005). This is especially troubling in light of current research that has indicated an earlier age-of-onset of the male voice change (Barresi & Bless, 1984; Cooksey, 1984; Hollien, Green, & Massey, 1994; Karr, 1988; Killian, 1999; Rutkowski, 1984). Also, despite the tremendous growth of minority student populations over the past decade, music education research regarding characteristics of various ethnic groups is scarce. Research on the characteristics of the voice change in ethnic groups is notably absent in the field of music education. As urban and suburban school districts become more largely composed of minority ethnicities (Fry, 2007), more information is needed on the characteristics of the voice change in urban and suburban school districts as well.

#### Design and Analysis

The research questions used to guide this study were: 1) What are the characteristics of the voice change in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade male students?; 2) What are the characteristics of the voice change in African American, White, and Hispanic male students?; 3) What are the characteristics of the voice change in male students of urban?; and 4) Do differences exist amongst African American, White, and Hispanic males in the age-of-onset of the male voice

change? A descriptive design was used to address Research Questions 1 through 3 and an ex post facto design was used to address Question 4.

### Summary of Results

Results for Research Question 1, “What are the characteristics of the voice change in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade male students?” revealed that the mean HTP and LTP descriptively declined with each progressive grade level. Approximately 46% of 4<sup>th</sup> grade participants were classified as changing voices with the majority of those participants in Stage 1 of the voice change. Approximately 62% of 5<sup>th</sup> grade participants were classified as changing voices with the majority of those participants in Stage 1 of the voice change. Several 5<sup>th</sup> grade participants had already progressed into the more advanced stages of the voice change (Stages 3-5). Approximately 67% of the 6<sup>th</sup> grade participants were classified as changing voices with a larger number of participants classified in Stages 3, 4, and 5 than the previous grade levels.

Results for Research Question 2, “What are the characteristics of the voice change in African American, White, and Hispanic male students?” revealed that a descriptively larger percentage of African American participants were classified as changing voices than Hispanic and White participants. Also, a larger percentage of African American and Hispanic participants were descriptively classified in the more advanced stages of the voice change (Stages 3-5) than White participants. Results also revealed that a larger percentage of 4<sup>th</sup> grade African American participants were categorized as changing voices than White and Hispanic 4<sup>th</sup> grade participants. African American participants also had a lower mean HTP in each grade level than White and Hispanic participants. The mean LTPs were comparatively uniform for each ethnic group across grade levels.

Results for Research Question 3, “What are the characteristics of the voice change in urban and suburban male participants?” revealed similar descriptive traits for urban and suburban male students; however, when evaluated by grade level and ethnicity, some unique characteristics were revealed. Urban participants in the 4<sup>th</sup> grade had a greater percentage of males classified as changing voices than suburban 4<sup>th</sup> grade participants. Urban African American, White, and Hispanic participants had a larger percentage of males classified as changing voices than suburban African American, White, and Hispanic participants. The mean HTPs for urban African American, White, and Hispanic participants were slightly lower than the mean HTPs for the suburban African American, White, and Hispanic participants.

A one-way, between-subjects ANOVA was performed to address Research Question 4, “Do differences exist amongst African American, White, and Hispanic males in the age-of-onset of the male voice change?” Ethnicity was used as the independent variable and the age-of-onset of the male voice change was used as the dependent variable. Results revealed no statistically significant differences amongst ethnic groups in the age-of-onset of the male voice change. The overall mean age-of-onset was approximately 11.20 years of age. The mean age-of-onset of the voice change for the African American participants was approximately 11.25 years of age, the mean age-of-onset for the White participants was approximately 11.05 years of age, and the mean age-of-onset for the Hispanic participants was approximately 11.30 years of age.

As with any study, caution must be taken when interpreting these results. Though the overall sample size was relatively large, the number of participants classified in Stage 1 (onset of the voice change) was small, thus limiting an ideal sample size in each ethnic group for purposes of the ANOVA. Also, because the participants were volunteers, the findings may not accurately reflect the characteristics of the voice change for those students who did not volunteer or were

not able to return the signed consent and assent form needed to participant in the study. It must also be noted that this study took place in the last month of the school year. Results should be viewed cautiously and not generalized beyond the sample population used in this study.

A final caution of the study's findings involves the categorization of each participant's vocal range in a voice change stage. Though all attempts were made to accurately and objectively categorize each student into one of Cooksey's voice change stages, an element of subjectivity was inescapable and should be acknowledged.

## Discussion

The purposes of this study were to describe the characteristics of the changing male voice in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade students using Cooksey's maturation stages and, to compare the age-of-onset of the male voice change in African American, White, and Hispanic male students. Participants ( $n = 197$ ) were volunteers from urban and suburban public schools in the North Texas region and represented African American ( $n = 62$ ), White ( $n = 58$ ), and Hispanic ( $n = 77$ ) 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade male students. All participants were recorded in the last month of the school year individually performing simple vocal exercises and then classified using Cooksey's voice change stages: Midvoice I, Midvoice II, Midvoice IIA, new voice, and emerging adult voice. Four research questions were used to direct this study.

### *Research Question 1*

Research Question 1 asked, "What are the characteristics of the voice change in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade male students?" Results revealed that nearly 46% of the 4<sup>th</sup> grade participants were classified as changing voices with the majority of those participants categorized in Stage 1 of the

voice change. Some 4<sup>th</sup> grade participants were already in Stages 2 and 3 of the voice change indicating that perhaps some males encounter the onset of the voice change earlier than 4<sup>th</sup> grade. Research studying the voice change in 3<sup>rd</sup> grade males may be warranted in order to evaluate whether or not changing voices can be found. If the voice change is occurring as early as 3<sup>rd</sup> grade, elementary music educators may need to adjust current teaching practices and be informed on the characteristics of the male voice change in order to properly guide emerging male adolescents through the beginning stages of the voice change.

Results for the 5<sup>th</sup> grade participants revealed that over 60% were classified as changing voices. Killian (1999), however, found that only 50% of the 5<sup>th</sup> grade participants in her study could be classified as changing, which may indicate a trend toward an earlier occurrence of the voice change. Killian (1999) also indicated that the 5<sup>th</sup> grade participants in her study “had examples of every voice stage except the final Stage V [*sic*] (Settling Baritone)” (p. 365). Results from this study found at least one participant in every stage of the voice change including Stage 5, which may counter Cooksey’s (1999) claim that Stage 5 begins around 14 and 15 years of age (p. 17). Elementary music teachers may need guidance on how to provide opportunities for emerging adolescent males in their class to be successful through singing. Current elementary music literature and curriculum geared toward the unchanged, treble voice may not allow for every male in the music classroom to be successful.

Results for the 6<sup>th</sup> grade participants revealed that nearly 67% of the participants were categorized as changing voices; however, a study by Killian (1999) found over 80% of the 6<sup>th</sup> grade participants to be classified as changing. The differences between these two findings could be caused by differences in sample size or by measurement techniques. Killian (1999) did reveal that a large number of her participants had difficulty matching pitch, which may have led

to a misclassification of those participants' voice change stage. Many male students who have difficulty matching pitch are unable to match higher pitches even though their voice may be able to produce those higher sounds. Because of those participants' inability to match pitch, their vocal ranges, as I measured them, may not have truly reflected their true vocal ranges. Such measurement error may have led to those participants being classified in more advanced stages of the voice change than they truly were. Rutkowski (1984) found only 50% of 6<sup>th</sup> grade participants to be changing voices whereas Karr (1988) and Friesen (1972) concluded that the large majority of 6<sup>th</sup> grade males in each of their respective studies were unchanged voices. These studies, with the exception of the Friesen study, had small sample sizes; therefore, the findings should be taken with caution. The Friesen study was conducted before Cooksey's voice change classification system was developed which may account for the disparate results found between the Friesen study and the other studies discussed.

The current study may be beneficial in terms of its measurement techniques, which incorporated the use of digital analysis to determine vocal range instead of the use of a stimulus pitch, such as a piano. In addition, the current study sampled from the entire 6<sup>th</sup> grade male population with all of the volunteers being in either an instrumental ensemble or a non-music fine art elective instead of only sampling choir members.

Results of this study show that a large number of males are encountering the voice change in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grades. Collegiate music educators might consider increasing efforts to educate and inform upper elementary music teachers and preservice elementary music teachers on the characteristics of the male voice change and on proper techniques for training and guiding these emerging adolescents' mutating voices. Although much of the literature regarding male adolescent vocal pedagogy has been directed to the middle school choir director, music

education scholars may consider enlarging the intended audience to include upper elementary school music educators. Instructional techniques currently used by effective middle school choir directors to train and guide emerging adolescent males may be beneficial to upper elementary music teachers.

Elementary music educators may also need to adjust current practices in order to better accommodate the changing male voice in the elementary music classroom. Such accommodations may include a reevaluation of the music literature used in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade music classes. A review of elementary music curriculum may reveal that ranges of many songs used in the music class may not fall within the ranges of the males in various stages of the voice stage. If males do not feel that they are successful at singing in the elementary music classroom, it is reasonable to assume that those males may not feel as though they are good singers and may not pursue singing in future choral programs in school or outside of school.

Elementary music educators may also want to consider segregating males and females during the 4<sup>th</sup> and 5<sup>th</sup> grade music specials class time. Some middle school choir directors already employ this strategy in order to focus on assisting adolescent males through the tumultuous time of vocal change. Perhaps it is time for upper elementary music educators to consider employing this strategy. Gender-segregated upper level elementary music classes would allow music teachers to discuss more freely the characteristics of the voice change with the boys in their classes and better track the vocal development of each maturing male. Music selection could be made easier for music educators once they are aware of the vocal ranges of the male singers in each class, which may allow more male students to become more successful singers. An environment in which developing males can freely discuss the difficulties associated



with their changing voices and obtain informed training without fear of embarrassment may be more effective than an integrated gender elementary music class.

The results of this study may not only affect current practices of elementary music teachers, but also children's choir directors. Most children's choirs perform treble voice literature ranging from SA to SSAA settings. Audition or selection procedures for these choirs may unintentionally discriminate against some males who, by no fault of their own, cannot adequately sing in the necessary vocal range of a children's choir member due to vocal maturation. Children's choir directors may wish to consider adjusting the voicing of their choirs in order to allow these vocally maturing males a chance to continue singing at a high caliber despite the voice change. Adjustments in the voicing of the music would allow an opportunity for unchanged and changing male voices to be a part of such prestigious ensembles. Although inclusion of changing male voices in the children's choir would encourage male participation, it would also alter the traditional treble sound of the choir. Choral voicing for a choir with changing male voices would more than likely include cambiata or tenor parts. Children's choir directors might consider establishing a choir that includes changing male voices while also maintaining a traditional, treble-voice children's choir.

### *Research Question 2*

Research Question 2 asked, "What are the characteristics of the voice change in African American, White, and Hispanic male students?" Results showed that almost 70% of the African American participants were classified as changing voices whereas approximately 57% of Hispanic participants and less than 50% of the White participants were classified as changing. However, all of the participants classified in Stage 5 of the voice change were Hispanic. Few

White participants were classified in Stage 4 of the voice change and no White participants were classified in Stage 5 of the voice change. These unique characteristics may warrant future research on the rate of vocal maturation in African American, White, and Hispanic males.

Results also revealed that the African American participants had the largest percentage of changing voices in the 4<sup>th</sup> grade. Hughes (1984) recorded similar findings with a larger percentage of African American males being classified as changing voices than White males in the 10-year-old age group. Some 4<sup>th</sup> grade African American participants were already in Stage 3 of the voice change indicating that those participants encountered the onset of their voice change before 4<sup>th</sup> grade. Descriptive results from this study indicate that while similarities do exist amongst African American, White, and Hispanic males, some unique characteristics appear to exist and may warrant more evaluation.

An evaluation of the vocal ranges of each ethnic group revealed some unique characteristics. Grade 4 African American participants had a slightly lower mean HTP than the White and Hispanic participants. The same was evident for the 5<sup>th</sup> grade African American participants. The 6<sup>th</sup> grade Hispanic and African American participants had lower mean HTPs than the White participants and the 6<sup>th</sup> grade Hispanic participants had the lowest mean LTP. Although these differences were the equivalent of a few semitones and may be attributable to error or chance, the results do warrant further research to evaluate more closely the vocal ranges of these ethnic groups so music educators can be more aware and sensitive to possible unique vocal attributes associated with each ethnicity.

### *Research Question 3*

Research Question 3 asked, “What are the characteristics of the voice change in male

students of urban and suburban schools?” Results revealed that a slightly larger percentage of suburban participants were classified as unchanged voices than urban participants; however, it must be noted that most of the urban participants were in the 6<sup>th</sup> grade, which may have accounted for this result. When separated by grade, a larger percentage of urban participants were classified as changing voices than suburban participants in 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grades. A larger percentage of 4<sup>th</sup> grade urban participants were classified in Stage 2 of the voice change than 4<sup>th</sup> grade suburban participants. Grade 5 suburban participants, however, had a larger percentage of students classified in Stages 3, 4, and 5 of the voice change than urban participants. Results also revealed that a larger percentage of urban African American, White, and Hispanic participants were classified as changing voices than suburban participants. Nearly 88% of urban African American participants were classified as changing voices.

Descriptive trends seem to indicate that male ethnic groups in urban school settings may have unique characteristics of voice maturation. Elementary music educators in urban school settings may encounter a larger percentage of males in various stages of the voice change than music educators in other school settings. Teacher preparation programs may consider developing effective instructional strategies for dealing with a larger representation of changing male voices in the elementary music classroom.

An evaluation of the mean vocal ranges of urban and suburban participants indicated slight differences in the mean HTP for 4<sup>th</sup> and 5<sup>th</sup> grade participants with the urban participants having a slightly lower mean HTP than the suburban participants. These results should be interpreted with caution since a much smaller sample of 4<sup>th</sup> and 5<sup>th</sup> grade urban students was measured in comparison to suburban participants. More research is needed, however, to

compare urban and suburban males, as well as rural males in the rate and age-of-onset of the male voice change.

#### *Research Question 4*

Research Question 4 asked, “Do differences exist amongst African American, White, and Hispanic males in the age-of-onset of the male voice change?” A one-way, between-subjects ANOVA revealed there were no significant differences in the age-of-onset of the voice change amongst the three ethnic groups – African American, White, and Hispanic. These results are in alignment with research that found no significant differences between White and African American males in their speaking fundamental frequency (Hollien & Malcik, 1967; Hollien, Malcik, & Hollien, 1965; Morris, 1997). The lack of significant difference between African American, White, and Hispanic male participants in the onset age of the voice change may indicate that these three ethnic groups begin the voice change at or around the same age. This finding supports Cooksey’s belief that “there appear to be many similarities in voice maturation among adolescent males, regardless of their nationality” (p. 90).

When interpreting these results, it should be noted that in the current study approximately 15% of the 4<sup>th</sup> grade participants were in Stages 2 and 3 of the voice change with the majority of those participants being African American, which indicates that the onset of the voice change may have occurred much earlier than this study measured. In contrast, over 30% of the 6<sup>th</sup> grade participants had not begun the voice change. In light of this, future research on ethnicity and the age-of-onset of the voice change should perhaps consider expanding the age of the sample to include 3<sup>rd</sup> through 8<sup>th</sup> grade males in order to obtain a more accurate estimate of the mean age-of-onset in order to better inform music educators.

The overall mean age-of-onset of the male voice change for participants in this study was approximately 11.20 years of age, which aligns with trends over the past 25 years indicating an earlier age-of-onset of the voice change (Barresi & Bless, 1984; Cooksey, 1984; Hollien, Green, & Massey, 1996; Killian, 1999). Cooksey (1984) concluded the approximate age-of-onset to be at 13.5 years of age where as Barresi and Bless (1984) found the age-of-onset to be 12.8 years of age with both research studies measuring 7<sup>th</sup> and 8<sup>th</sup> grade male students. Hollien, Green, and Massey (1996) concluded the mean age-of-onset of the voice change to be 13.4 years. Most recently, Killian (1999) concluded the age-of-onset in her 5<sup>th</sup> and 6<sup>th</sup> grade participants to be 11.74 years of age. Cooksey (1988) wrote, “For the majority of boys, voice maturation begins at twelve-thirteen years of age, reaches its most active phase between thirteen and fourteen, then tapers off between fifteen and eighteen” (p. 89). In light of the results of this study and more recent research, this statement may no longer be accurate.

### Limitations

Several possible threats to internal validity may have affected the outcomes of this study. A selection threat is a concern in this study due to the fact that the ethnic groups could not be manipulated and certain variables were not controlled for. Because of the use of an ex post facto design, causation cannot be determined. Future research measuring the voice change in various ethnic groups may consider controlling for variables such as socioeconomic status, health predispositions, as well as nutritional background which all could account for possible differences between groups.

Another internal validity threat that may have impacted the results of this study involve the testing procedures. Because I personally listened to all of the recording samples of each

participant, the possibility of instrument decay must be acknowledged; however, attempts were made to avoid such a threat. I attempted to measure the vocal exercises of participants from one school at a time and took short breaks in order to ensure each participant's recording received adequate and objective evaluation. Also, an outside reviewer was used in the pilot study to analyze the vocal exercises of each participant. Though the measurement of some participants' LTPs was found to be difficult in the pilot study, adjustments in the recording procedures of stressing to each participant the importance of slowly descending from high to low and holding the lowest note allowed for a more accurate assessment of each participant's LTP in the main study.

Though all attempts were made to avoid a history threat, several interruptions during the recording of the vocal exercises must be acknowledged. I was notified by the principal of the suburban middle school that a fire drill would occur during the scheduled recording session time. Because of this notification, I delayed the recording of one participant in order to exit the building for the fire drill. Once the fire drill was over, the participant was recorded. Some unexpected interruptions did occur such as intercom announcements. Any time such interruptions occurred, the recording was immediately stopped and, once the announcement was over, the participant re-recorded the vocal exercise that was interrupted.

The differential timeframes of student maturation may have also affected the results of this study since some participants may have entered a particular stage of the voice change immediately before or after the recording. For instance, a participant measured at the beginning of the study could have been classified as an unchanged voice, but could have progressed in to Stage 1 a few days or weeks later. Because this was not a longitudinal study, vocal changes over time could not be evaluated and therefore, the rate and exact ages of the onset of the voice

change could not be concluded. Also, some participants in this study were older than the average student in their grade level, which may imply that some had been retained. Caution should be taken when interpreting these results.

A final threat that must be recognized regards the external validity of the findings. Caution must be taken when generalizing this study's findings beyond the sample used. The three ethnic groups evaluated in this study all came from the North Texas region and generalizing these results to a population in other areas should be done with great caution. Also, only participants from urban and suburban schools were evaluated in this study, therefore, these results should not be generalized to rural male populations.

#### Recommendations for Future Research

This study documented larger percentages of upper elementary school male students entering the voice change than has been documented in past research. This earlier onset of the male voice change may require current teaching practices of elementary music teachers to be altered in order to adjust to this change. Future research could evaluate the current elementary music curriculum of 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grades in order to determine whether the ranges and keys of the music are accessible to changing male voices.

Though this study failed to find any significant differences between the ethnic groups on the age-of-onset of the male voice change, more research may still be warranted on this topic. As previously noted, several participants in the 4<sup>th</sup> grade had already entered Stages 2 and 3 of the voice change with the majority of those participants being African American and some participants in the 6<sup>th</sup> grade had not begun the voice change with a majority of those participants being White. In light of this, future research should consider measuring 3<sup>rd</sup> grade to possibly 8<sup>th</sup>

grade students in order to compare the mean age-of-onset of the male voice change for each ethnic group.

Researchers may also consider longitudinal studies aimed at studying the rate of the voice change for African American, White, and Hispanic males. Results from this study revealed unique characteristics of 4th grade African American participants with larger percentages of participants in Stages 2 and 3 of the voice change, which may indicate differences in the rate of vocal maturation in the first few stages of the voice change in the three ethnic groups evaluated in this study. If one ethnic group progresses more quickly through the first few stages of the voice change than other ethnic groups, music educators should be aware of such differences.

More research may also be needed on the vocal characteristics of young African American, White, and Hispanic prepubescent children. It could be possible that social and environmental factors account for differences in vocal range development of young children of various ethnicities. If differences in vocal characteristics such as vocal range exist before puberty, measurement techniques for determining voice change stage would need to be altered for each ethnicity.

Though more information regarding the characteristics of the voice change in African American, White, and Hispanic males has been gained through this study, more research is needed on the characteristics of the voice change in other ethnic groups like Asian male students as well as mixed ethnicities. Music educators should be exposed to as much information as possible concerning every ethnicity represented in his or her classroom in order for that music teacher to be effective in imparting musical concepts to every child.

Continued research on urban and suburban male students and the voice change is strongly encouraged and factors including socioeconomic status and prior health should also be



considered in order to evaluate whether school setting has any effect on differences in the age-of-onset or progression of the male voice change. More research is also needed on the characteristics of the voice change in rural males. Comparative analysis of male students enrolled in these three school types may be warranted.

Additional research is also needed on the voice change in choir and non-choir 6<sup>th</sup> grade males. Although this study attempted to measure choir and non-choir 6<sup>th</sup> grade males, no 6<sup>th</sup> grade choir members volunteered to participate. Other research studies have only measured 6<sup>th</sup> grade choir members. It could be that male students who are uncomfortable with their singing voice due to vocal maturation may not choose to participate in 6<sup>th</sup> grade choral programs. It may also be that males in the more advanced stages of the voice change feel more comfortable participating in 6<sup>th</sup> grade choral programs and those with unchanged voices feel ashamed or embarrassed of their treble voice and choose to participate in another fine art elective. More research is needed to evaluate these remaining questions so middle school choir directors know how to improve recruitment of males for their program.

Finally, despite attempts made over the past several decades to determine more accurately the vocal range and voice change stage of males, more research is needed to refine and objectify these measurements. Although this research study incorporated some digital analysis in order to determine vocal range, greater strides in objectifying vocal range measurement should be considered. As long as a researcher or music educator is left to subjectively make his or her determination of a male student's HTP and LTP, an element of error will always remain. The error in determining a male student's HTP and LTP directly affects the classification of the student in one of the voice change stages. Future research should look to the vocal science field in order to utilize digital software that can remove the human element and

objectify voice change measurement techniques. The utilization of modern technology and software may allow for a more accurate and objective understanding of the male voice change, which would better inform the music education community.

Research on the male voice change has continued to assist music educators in better understanding the male maturation process and has better informed instructional practices on effective ways to train and guide the changing male voice. While much of the literature regarding the male voice change has been directed at middle school choir directors, trends of an earlier age-of-onset of the male voice change may indicate that focus should now be placed on informing upper elementary music teachers of the characteristics of the male voice change. As the results of this study have revealed, larger percentages of 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grade males are encountering the male voice change. Elementary music teachers in urban and suburban school settings must be prepared to guide emerging adolescent males through the maturation process and be able to provide singing experiences in which males of various ethnic backgrounds in the elementary music classroom can be successful.

APPENDIX A  
INSTITUTIONAL REVIEW BOARD LETTERS

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UNIVERSITY OF  
NORTH TEXAS  
DISCOVER THE POWER OF IDEAS

OFFICE OF THE VICE PRESIDENT FOR RESEARCH  
Office of Research Services

February 15, 2008

Ryan Fisher  
Department of Music Education  
University of North Texas

RE: Human Subjects Application No. 08-052

Dear Mr. Fisher:

In accordance with 45 CFR Part 46 Section 46.101, your study titled "The Effect of Ethnicity on the Onset of the Male Voice Change" has been determined to qualify for an exemption from further review by the UNT Institutional Review Board (IRB).

Enclosed is the consent document with stamped IRB approval. Please copy and **use this form only** for your study subjects.

No changes may be made to your study's procedures or forms without prior written approval from the UNT IRB. Please contact Shelia Bourns, Research Compliance Administrator, ext. 3940, if you wish to make any such changes.

Sincerely,



Kenneth W. Sewell, Ph.D.  
Chair  
Institutional Review Board

KS:sb

CC: Dr. Debbie Rohwer

UNT  
UNIVERSITY OF  
NORTH TEXAS  
DISCOVER THE POWER OF IDEAS

May 2, 2008

OFFICE OF THE VICE PRESIDENT FOR RESEARCH  
Office of Research Services

Ryan Fisher  
Department of Music Education  
University of North Texas

Institutional Review Board for the Protection of Human Subjects in Research (IRB)  
RE: Human Subject Application #08-052

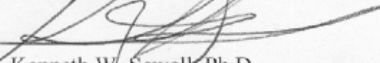
Dear Mr. Fisher:

The UNT IRB has received your request to modify your study titled "The Effect of Ethnicity on the Onset of the Male Voice Change." As required by federal law and regulations governing the use of human subjects in research projects, the UNT IRB has examined the request to include additional data collection sites and to change the consent form to include the compensation of a raffle to win an iPod Nano 4 GB. The modifications to this study are hereby approved for the use of human subjects.

The IRB must also review this project prior to any other modifications made.

Please contact Shelia Bourns, Research Compliance Administrator, at (940) 565-3940, or Boyd Herndon, Director of Research Compliance, at (940) 565-3941, if you wish to make changes or need additional information.

Sincerely,



Kenneth W. Sewell, Ph.D.  
Chair  
Institutional Review Board

KS/sb

CC: Dr. Debbie Rohwer

APPENDIX B  
INFORMED CONSENT/ASSENT FORM

University of North Texas Institutional Review Board

Informed Consent Form

Before agreeing to your child's participation in this research study, it is important that you read and understand the following explanation of the purpose and benefits of the study and how it will be conducted.

Title of Study: The Effect of Ethnicity on the Onset of the Male Voice Change

Principal Investigator: Ryan Fisher, a graduate student in the University of North Texas (UNT) College of Music.

**Purpose of the Study:** You are being asked to allow your child to participate in a research study which involves the male voice change. Research shows that boys may be entering puberty at earlier ages than before and that some ethnic groups enter puberty earlier than others. This study specifically looks at the age of onset of the male voice change and whether White, African American, and Hispanic boys enter the voice change at different times.

**Study Procedures:** Your child will be asked to sing simple vocal exercises into a microphone. These exercises will be audio recorded. This procedure will take about 2-3 minutes of your child's music class time.

**Foreseeable Risks:** No foreseeable risks are involved in this study. Some students' voices may crack during the exercise and may cause them to be slightly embarrassed. In this event, I would reassure them that this is completely normal as the voice begins to change. If their embarrassment is severe, then their participation in this study would be discontinued out of respect for the student.

**Benefits to the Subjects or Others:** The project may benefit the field of music education by informing educators of the characteristics of the male voice change in White, African American, and Hispanic students, which may suggest a need to adjust current instructional practices. The student may also benefit by becoming more aware of where they are in their vocal development during maturation.

**Compensation for Participants:** Your child's name will be included in a raffle to receive an iPod Nano, 4 GB as compensation for his participation in this study.

**Procedures for Maintaining Confidentiality of Research Records:** All records for this research study will not contain any personally identifiable information about your child. Your child's personal information will be coded and protected by the researcher. No other students or teachers will hear the audio recording of the vocal exercises. These recordings will be maintained for three years upon completion of the study and will only be for the researcher's use. After the three-year period, the recordings will be permanently erased. The confidentiality of your child's individual information will be maintained in any publications or presentations regarding this study.

Office of Research Services  
University of North Texas  
Last Updated: August 9, 2007

1 of 3

**Questions about the Study:** If you have any questions about the study, you may contact Ryan Fisher at telephone number [REDACTED], or the faculty advisor, Dr. Debbie Rohwer, UNT College of Music, at [REDACTED].

**Review for the Protection of Participants:** This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-3940 with any questions regarding the rights of research subjects.

**Research Participants' Rights:** Your signature below indicates that you have read or have had read to you all of the above and that you confirm all of the following:

- You understand possible benefits and the potential risks and/or discomforts of the study.
- You understand that you do not have to allow your child to take part in this study, and your refusal to allow your child to participate or your decision to withdraw him/her from the study will involve no penalty or loss of rights or benefits. The study personnel may choose to stop your child's participation at any time.
- You understand why the study is being conducted and how it will be performed.
- You understand your rights as the parent/guardian of a research participant and you voluntarily consent to your child's participation in this study.
- You have been told you will receive a copy of this form.

\_\_\_\_\_  
Printed Name of Parent or Guardian

\_\_\_\_\_  
Signature of Parent or Guardian

\_\_\_\_\_  
Date

APPROVED BY THE UNT IRB

DATE: 2/15/08  
*[Signature]*



### Child Assent Form

You are being asked to be part of a research project being done by the University of North Texas College of Music.

This study involves understanding the characteristics of the male voice change in White, African American, and Hispanic students.

You will be asked to sing a simple vocal exercise into a microphone. This vocal exercise will be performed only for the researcher. This will take about 2-3 minutes of music class time.

If you decide to be part of this study, please remember you can stop participating any time you want to.

If you would like to be part of this study, please sign your name below.

\_\_\_\_\_  
Printed Name of Child

\_\_\_\_\_  
Signature of Child

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Principal Investigator

\_\_\_\_\_  
Date

APPROVED BY THE UNT IRB

DATE: 2/15/08  
SB

## University of North Texas Institutional Review Board

### Forma de Consentimiento

Antes de considerar la participación de su hijo en este estudio de investigación, es importante que lea y entienda la explicación siguiente sobre el propósito y los beneficios del estudio y como va a estar conducido.

**Título del Estudio:** El Efecto de la Etnicidad en el Principio del Cambio de la Voz del Hombre

**Investigador Principal:** Ryan Fisher, un estudiante de postgrado en La Universidad de North Texas (UNT) Colegio de Música

**Propósito del Estudio:** Le solicitamos que deje a su hijo participar en un estudio de investigación, que involucra el cambio de la voz del hombre. Hay investigaciones que muestran que los hombres adolescentes pueden estar entrando en pubertad en edades más tempranas que antes y que algunos grupos étnicos entran a la pubertad más temprano que otros. Específicamente, este estudio mira a la edad en que comienza el cambio de la voz de hombres jóvenes para ver si el tiempo del cambio es diferente a los hombres Blancos, Hispanos, y Afro-americanos.

**Procedimiento del Estudio:** Le vamos a pedir a su hijo cantar ejercicios simples a un micrófono. Se van a grabar los ejercicios. Este procedimiento va a tomar 2-3 minutos del tiempo de la clase de música.

**Riesgos Previsibles:** No hay riesgos previsibles involucrados en este estudio. Algunas de las voces de los muchachos se pueden cascar y es posible que cause un poco de pena para ellos. En el evento de que pase esto, yo haría lo necesario para tranquilizarlos y decirles que es completamente normal. Si su turbación es fuerte, su participación sería suspendida por respeto al estudiante.

**Beneficios a los Sujetos o Otros:** El proyecto puede beneficiar la esfera de la educación musical a través de informar a los educadores de las características del cambio de la voz del hombre en estudiantes Blancos, Hispanos, y Afro-americanos, lo cual puede sugerir la necesidad de ajustar los ejercicios corrientes de instrucción. El estudiante puede beneficiarse también, entendiendo mejor donde cae en el desarrollo vocal durante su pubertad.

**Compensación para los Participantes:** El nombre de su hijo/hija será incluido en una rifa para ganar un iPod Nano, 4 GB como premio por participar en el estudio.

**Procedimientos para Mantener La Confidencialidad de los Documentos de Investigación:** Los documentos de esta investigación no van a contener información personal o identificable sobre su hijo. La información personal de su hijo va ser protegida por el investigador. Ni estudiantes ni maestros van a escuchar la grabación de los ejercicios. El investigador va a guardar las grabaciones por tres años después de completar los ejercicios, pero sólo va a mantenerlas para el uso del investigador. Después del periodo de tres años, se van a borrar. La

confidencialidad de la información solicitada de su hijo será mantenida en cualquier publicación o presentación con referencia a este estudio.

**Preguntas Sobre el Estudio:** Si hay cualquier pregunta sobre el estudio, puede contactar a Ryan Fisher a [REDACTED], o a la consultiva de la facultad, Dr. Debbie Rohwer, UNT College of Music, a [REDACTED].

**Análisis para la Protección de Participantes:** Esta investigación ha sido revisada y aprobada por el UNT Institucional Rebién Borrada (IRB). Se puede contactar al UNT IRB a 940-565-3940 con preguntas sobre los derechos de los participantes.

**Derechos de los Participantes de la Investigación:** Firmar abajo indica que ha leído o escuchado a otra persona leer todo arriba y que confirme todo lo siguiente:

- Entiende los beneficios posibles y los riesgos potenciales y/o preocupaciones del estudio.
- Entiende que no es requerido dejar a su hijo participar en el estudio, y si quiere negar o quitar la participación de su hijo, no habrá pérdida de derechos o beneficios. El personal del estudio puede escoger parar la participación de su hijo en cualquier momento.
- Entiende porque se va a conducir este estudio y como va ser ejecutado.
- Entiende sus derechos como padre/guardián del participante y su consentimiento es voluntario para la participación de su hijo en el estudio.
- Le ha dicho que recibirá una copia de esta forma.

\_\_\_\_\_  
Nombre de Padre o Guardiana

\_\_\_\_\_  
Firma del Padre o Guardiana

\_\_\_\_\_  
Fecha

APPROVED BY THE UNT IRB  
DATE: 2/15/08  
RB

### Forma de Aprobación del Hijo

Te estamos pidiendo participar en un proyecto de investigación hecho por la Universidad de North Texas Colegio de Música.

Este estudio involucra entender las características del cambio de la voz del hombre en los estudiantes Blancos, Afro-americanos, y Hispanos.

Te vamos a pedir cantar ejercicios simples a un micrófono. Este ejercicio vocal será cantado solo para el investigador. Este procedimiento va a tomar 2-3 minutos del tiempo de la clase de música.

Si escoges participar en este estudio, acuérdate que puedes parar participar en cualquier momento que quieras.

Si quisieras ser parte de este estudio, favor de firmar en el espacio abajo.

\_\_\_\_\_  
Nombre de Estudiante

\_\_\_\_\_  
Firma de Estudiante

\_\_\_\_\_  
Fecha

\_\_\_\_\_  
Firma del Investigador Principal

\_\_\_\_\_  
Fecha

APPROVED BY THE UNT IRB  
DATE: 2/15/08  
*[Signature]*

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