VOCAL AGILITY IN THE MALE ADOLESCENT CHANGING VOICE

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Doctor of Philosophy

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by

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Dr. Wendy Sims, Dissertation Supervisor

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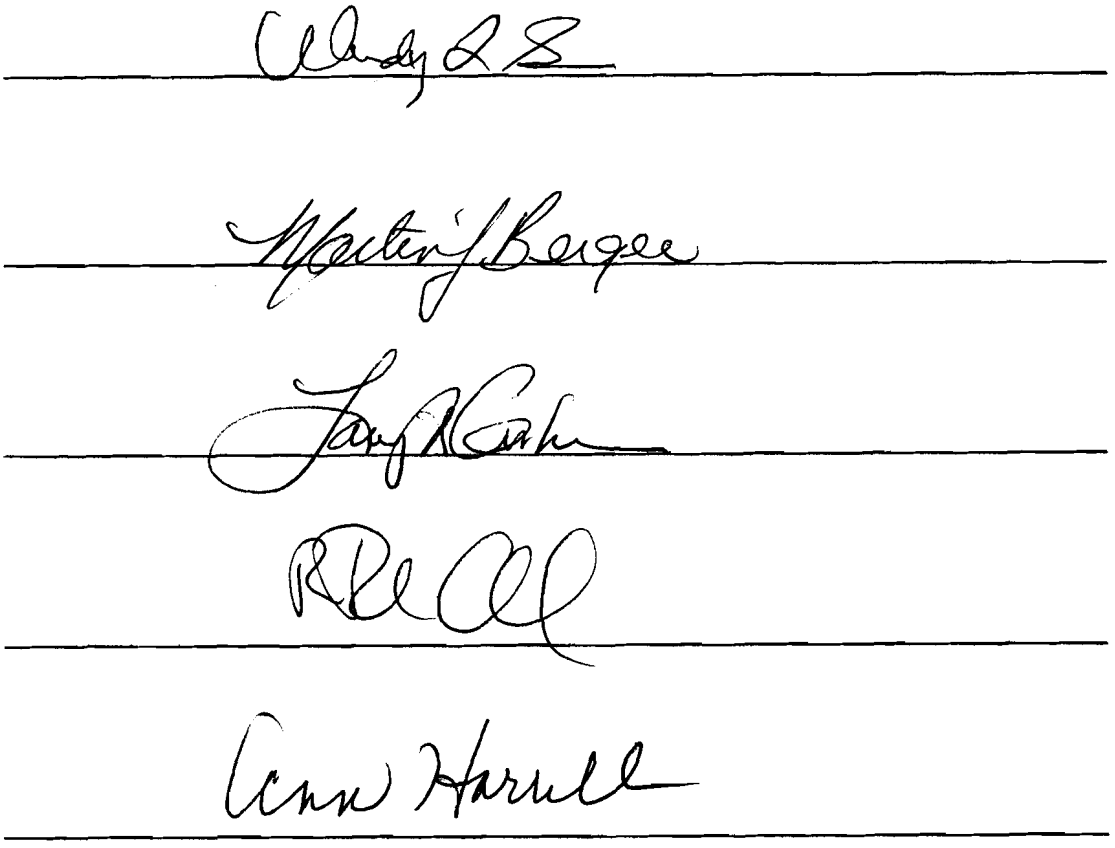
The undersigned, appointed by the Dean of the Graduate School,
Have examined the dissertation entitled.

VOCAL AGILITY IN THE MALE ADOLESCENT CHANGING VOICE

Presented by Sally Hook

A candidate for the degree of Doctor of Philosophy

And hereby certify that in their opinion it is worthy of acceptance.



DEDICATION

This document is lovingly dedicated to my husband, Marty, who gave me emotional support, technological advice, and educational wisdom throughout this process.

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ABSTRACT

This study was designed to investigate agility in adolescent changing voice males. Participants ($N = 58$), 11.5 to 15.9 years old, were from six Midwestern schools. The boys had varied experience in school and/or community choirs.

Participants each were assigned to one of five stages of vocal maturation according to Cooksey's range stages, and to one of the two Cooper cambiata/baritone categories. These assignments were based on the participant's lowest terminal range pitch, and other observed tone quality factors. Each participant was recorded while singing a stepwise song pattern at increasing tempi, with and without lyrics. Judges later listened to the randomized recordings, and assigned agility scores for each participant at each of the six tempi, with and without lyrics.

Agility scores were statistically analyzed with a 3-way ANOVA. Results were that (a) mean agility scores were increasingly higher from Cooksey stage one through stage five, (b) scores were significantly higher with lyrics than without lyrics, (c) there were significant differences related to tempo, with slower tempi associated with higher scores, and (d) there was a significantly positive relationship between mean agility scores and participants' years of choral experience. A summary of the findings was that:

1. Boys in progressively later stages of voice change were judged to be increasingly more agile (singing a stepwise melisma) than in earlier stages, on average.

2. Differences between cambiata and baritone were statistically significant for Cooper's range categories, but not for Cooksey's five stages of voice change.
3. Agility was more accurate when lyrics were employed, than when "ahhh" was used to sing the stepwise exercises.
4. Agility decreased as tempo increased.
5. Agility correlated positively with years of choral experience.

Implications for music educators include:

1. If very fast passages exist in solo or choral repertoire, boys in the earlier midvoice Cooksey voice range stages (or Cooper's cambiata category) may have more difficulty than boys in later stages (baritone) of voice change.
2. Songs using lyrics (consonant and vowel combinations) may be easier for changing voice boys to sing accurately, as compared to melismatic songs or passages using a single vowel.
3. As the tempo increases, changing voice students may have more difficulty with vocal agility.
4. Choral repertoire such as European Baroque music may be more accessible as changing voice boys' choral experience increases.

CHAPTER ONE

Introduction

Male adolescent singers experience vocal problems unique to their developmental level. People all over the world are aware of the special "rite of passage" from childhood to adulthood that all normal young males go through as they begin to mature during puberty. Young males, usually ten to sixteen years of age, begin to notice primary and secondary sexual characteristic changes that are results of natural hormonal changes within the body. Fluctuations in range, tone quality, and the ability to move the voice easily cause some boys to think that they can no longer sing. It is the responsibility of music educators to share information with their students about what is normal during adolescent vocal mutation. This study dealt with the growth of the male larynx during pubescence and adolescence, explored the knowledge base associated with the voice change, and explored agility as one facet of that voice change.

Background of the Study

Before and even into the 20th century, many music educators believed that boys should not sing during vocal mutation (Behnke & Browne, 1885; Weiss, 1950). Swanson (1977) indicated that one reason for this perspective might have been that the conductors of all male choirs in Europe were educationally ill equipped to deal with the idiosyncrasies of the mutational voice. It was just easier to ask young men to wait until after their voices had settled before they re-joined the choir.

Educators and researchers have sought to replace myths associated with the voice change with facts, by finding out more about what is normal during this vocal mutation. Leck (2000) stated past theories commonly employed by music educators in regard to the

adolescent male voice that led to misunderstandings in the field of choral music: "Let the voice rest! It is harmful to disturb the voice during mutation. Dismiss the singer and don't worry about it (p. 7)".

Research begun by Cooper (1953), McKenzie (1956), Swanson (1959), and continued by Cooksey (1977, 1984), Groom (1979), Lee (1980), Baressi and Russell (1984), Cooksey and Welch (1998), Killian (1996, 1999) and others has suggested that "changing voice" or vocal mutation occurs between the ages of eleven and fifteen years in human males. They observed tone quality, range limitations, and physical characteristics associated with the changing voice. They made recommendations for voice training and appropriate repertoire for students experiencing voice change. One of the specific observations, loss of vocal agility during certain stages of vocal mutation that was observed by earlier researchers, was explored and further described in this study. Information about this topic may be helpful to singers and teachers of singers as they strive to deal with obstacles that may be in the way of the goal of beautiful, healthy singing. As reported by Adler (1999) when speaking of surveyed music educators, "84.8% [of the 85.3% responding educators who received training in voice change] felt that their formal training had **not** prepared them adequately to teach boys with changing voices. Only 70.6% of respondents taught their students about the voice change process (p. 30)." Therefore, music educators need more information and understanding about voice change so that they may (a) help the students understand that what they are experiencing is normal, and (b) plan beneficial singing exercises and appropriate solo and ensemble literature for young people.

In addition, as Groom (1984) reported during The Research Symposium on the Male Adolescent Voice at the State University of Buffalo, "The question of singing during the period of vocal mutation poses a problem to some teachers" (1984, p. 80). Groom illustrated her point with a quotation provided by Gustafson (1965), from George Faxon, who was Head of the Organ Department at the New England Conservatory of Music. In a letter to Gustafson, Faxon explained emphatically why boys should not be encouraged to sing during the voice change:

> Almost anyone but a complete musical incompetent would realize that the voice during the changing period is unsettled and undeveloped—what in the world use could be made of this in an attempt to really decently perform music? Most advanced voice teachers fully concur that the voice of the male human should be left alone during the changing period. . . (Gustafson, 1965, p. 17)

This conflict about what is best to teach young music students has led to continued research in the field of vocal mutation.

In study that became influential, Cooksey (1977) identified five stages of vocal development that every normal adolescent male experiences during this phase of his life. Contrary to popular belief, these stages were shown to be a gradual process, not a sudden change from a higher to a lower pitch range. All normal male voices pass through these stages; the length of time for each stage differs with each individual. Gackle (1995), Killian (1996) and others have used the Cooksey stages as a basis for further research in the male and female changing voice.

The five stages of vocal development in male voices as identified by Cooksey (1977, 1983, 1984,) were Stage I: Midvoice I, Stage II: Midvoice II, Stage III: Midvoice IIA, Stage IV: New Baritone, and Stage V: Settling Baritone. The gradual changes in

adolescent male pitch ranges have been demonstrated in longitudinal studies by Cooksey, Beckett, and Wiseman (1983). Participants were recorded at each stage of vocal development, and pitch ranges were compared with original studies by Cooksey (1977).

More recently, stage names have been revised by Cooksey (2000) to Stage I: Midvoice I; Stage II: Midvoice II; Stage III: Midvoice IIA; Stage IV: Newvoice; and Stage V: Emerging Adult Voice.

Need for the Study

Identification of the stages through which each adolescent passes has been important for discoveries concerning the mysteries of vocal maturation. Stage identification has been crucial in solving the bigger problem for educations, assigning appropriate repertoire for adolescent students enrolled in choirs. In addition, observations made by researchers report that students in this age range demonstrate a decrease in volume, some breathiness in tone quality, and decrease in vocal agility (Cooksey, 1977; Groom, 1984). Agility, the ability to move easily or quickly from one pitch to another, is necessary to produce an aesthetic effect in singing. Agility also dictates the tempo with which a singer may accomplish a rapid rhythmic pattern involving pitch changes within a song. The decrease in vocal agility has been mentioned as a characteristic of the normal maturation process for boys (Cooper, 1953; Cooksey, 1977; Groom, 1984). More information about the average agility capacity for males during each stage of vocal mutation could further assist the educator in assisting individual singers and in selection of appropriate repertoire for this age group.

The purpose of this investigation is to identify the average tempo at which an adolescent can produce pitches accurately during each of the five mutational stages.

Concern for the efforts of adolescent singers has led this investigator to question the feasibility of encouraging young singers to attempt to sing vocal literature at tempi faster than what their developmental potential may allow. The object of this study is to investigate the vocal agility of adolescent singers, and to compare the average agility level among varying mutational stages.

The Problem

Determination of the average agility capability for the adolescent singer is considered in this inquiry. Through examination of vocal agility in adolescent males, questions concerning appropriateness of solo and choral repertoire may be addressed. Answers to the following questions were sought:

1. Does vocal agility change as boys progress through voice change stages as identified by Cooksey and Cooper?
2. Is there a difference in vocal agility between a vocalise sung with lyrics and a vocalise sung with the voiced vowel "ahhh?"
3. Are there tempi at which the voice is more or less agile?
4. Is there a relationship between years of choir experience and vocal agility?

Significance of the Study

The confusion about what really happens to the physical structure of the larynx during adolescent vocal mutation has remained for centuries. Singing has been taught in public schools in America since Lowell Mason's beginning in Boston in 1838, and around the world for many years. In spite of the inclusion of choral music in schools, there has been controversy about which students should be allowed the opportunity to participate in a choral music program. In 1994, the Music Educators National

Conference wrote and adopted National Standards for Education in the United States of America. Given as "Standard No. 1, "Singing, alone and with others, a varied repertoire of music," (MENC, 1994) the responsibility of music educators to provide the best possible opportunities for singing is clear. Yet, many reports have been published about the fact that some educators may continue to cling to beliefs that singing during the voice change may be harmful to the future adult voice (Brodnitz, 1983; Brown, 1996; Chapman, 1989; Cooper, 1964; Friar, 1999; Garretson, 1998).

In contrast, other musicians and educators (Cooksey, 1977, 2000; Groom, 1984) agreed that singing should continue during the normal vocal maturational process. Frederick Swanson (1977) remarked,

> Unfortunately, the boy singer, in this rapidly shifting vocal development, can be exposed to more faulty use, more bad teaching and more emotional strain than is the case with his female counter-part. Not all of those who are responsible for the training of the boy voice during these ten years have the specific knowledge nor the techniques needed to train their boy students properly, nor do all adults have the appreciation for or sympathetic understanding of both the boy's voice and boy himself as a person.
>
> This is why in America we lose so many boy singers along the way. It is no secret that there is a chronic shortage of men singers in the United States… . . . Those who are responsible for the development of boy singers need special techniques and special knowledge, and far too many do not know those techniques nor have that knowledge. (p. 2)

Purpose of the Study

Those who have agreed that singing should be encouraged during pubescence and adolescence have needed a background of empirical research to assist them in the education of today's youth. For this reason, research in the field of adolescent changing voice has been continued. Although many aspects of the changing voice have been explored, the agility or flexibility of this mutational period has been observed (Baressi &

Russell, 1984; Cooksey, 1977, 2000; Cooper, 1953; Groom, 1984) but not described beyond that fact.

The purpose of this study has been to measure the agility of boys' voices and compare it to agility levels of differing stages of development. Implications for the music educator have included appropriate expectations of the capabilities of middle level singers and appropriate selection of repertoire for this age group.

Definitions

The following terms are used frequently in this study. Operational definitions are provided below for clarity.

"Accurate pitch" = Adjudicator's perception of how close the pitch is within a quarter-tone or .50 of a half-step.

"Agility" = Speed with which a singer may accurately move from one pitch to another.

"Alto" = Lowest voice part sung by adult females and by prepubescent or changing voice males.

"AVC" = Acronym for "Adolescent Voice Change."

"Baritone" = Next to the lowest voice part assigned to adult males or adolescent males in the later stages of voice change.

"Bass" = Lowest voice part assigned to adult males.

"Cambiata" = Term coined by Irvin Cooper meaning "changing voice."

"Cambiate" = Term coined by Irvin Cooper identifying a male singer in the earlier stages of changing voice.

"Certain Singer" = One who can sing with relative accuracy of intervallic pitches and a constant tonal center.

“Cooksey Stages” = The five stages through which boys progress during AVC as defined in research by John Cooksey (1977, 2000).

“Cooper Categories” = The two categories called “cambiata” and “baritone” through which boys progress during AVC as defined by Irvin Cooper (1953).

“Cricothyroideus muscle” = Muscle that tightens the vocal cords.

“Diphthong” = Two vowel sounds merging into one syllable.

“Fry Register” = Lowest possible phonation of humans.

“General Linear Model” = A statistical test used to analyze the repeated measures research design.

“Glottis” = Opening between the vocal folds when phonation is not taking place.

“HTP (highest terminal pitch)” = The highest pitch possible in a vocal range.

“Laryngeal” = That which is of or associated with the larynx.

“LTP (lowest terminal pitch)” = The lowest pitch possible in a vocal range.

“Melismatic” = A florid passage consisting of very fast rhythmic notes of various pitches.

“Modal Register” = The vocal register in the singing voice also known as “chest register” or “real voice.” The range of pitches below the falsetto and above “fry register.”

“Modulating Singer” = One who sings with relatively accurate intervallic pitches, but who modulates to one or more key centers probably for comfort of vocal production.

“Mutation” = Natural physiological growth of the voice during and after puberty.

“Passaggio” = Overlapping pitches between vocal registers.

“Phonation” = Production of sound by a human vocal mechanism.

“Phonastensia” = Audible fatigue of the voice.

"Range" = All pitches from highest terminal pitch to the lowest terminal pitch which can be produced by a singer.

"Register shifts" = Audible shifting change of vocal quality from modal (chest) to loft (head or falsetto) register. Also called lifts.

"Soprano I" or 1st soprano = The highest soprano voice part. The highest notes capable of adult females and prepubescent boys.

"Soprano II" or 2nd soprano = The next to the highest soprano voice part.

"Tenor" = The highest voice part assigned to adult males.

"Tessitura" = The more comfortable range of pitches within the overall range of the voice.

"Thyroartenoideus muscle" = Muscle that relaxes the vocal cords.

"Uncertain Singer" = One who sings randomly with no tonal center.

"Vocalise" = Short composed melody or pattern used in the study.

"WithL" = Sung with lyrics.

"WithoutL" = Sung without lyrics.

Limitations

The participants were boys in fifth through ninth grades. Participants may or may not have been enrolled in music classes at the time of the study. No control was possible for psychological factors such as embarrassment or anxiety of the participant. However, the researcher tried to make the participant feel at ease during the audio-recording session with smiles and encouraging positive comments. When possible, the subject recorded the data in a room apart from other student peers.

Structure of the Report

A review of related research is presented in Chapter Two of this study. Important research associated with vocal maturation for males is included. Research findings concerning pitch, range, and tessitura are presented as background for the determination of vocal mutation stages used in the interpretation of the data. Examination of singing characteristics, that is, vocal agility and flexibility, are presented as they integrate with typical voice change range characteristics. Included are publications regarding adolescent vocal mutation as they exist in areas of study regarding the maturation of the larynx, the identification of abilities and limitations for singers, the field of teaching individual singers in voice studios, and in choral music education and its implications of appropriate choice of repertoire for the adolescent male.

Chapter Three contains the study design and a detailed method including subject selection, selection and use of equipment, structuring of vocalises and accompanying questionnaire, and an adjudication instrument for the judges. It also describes the method collection of the data collection and analytical procedures.

The results are presented in Chapter Four. Descriptive data and results of standard analyses are included. Comparisons of agility measurements with and without lyrics are analyzed. Comparisons of agility measurements among tempo changes are analyzed. Presentations of average vocal agility within range classifications are made. Chapter Five contains a summary of the study, conclusions for researchers and educators, and implications for further research in the field of adolescent vocal music.

CHAPTER TWO

Review of Literature

Literature regarding the male adolescent voice change or vocal mutation abounds in many areas: (a) philosophies of whether or not the voice should rest during this time; (b) correlations among other secondary sexual characteristics and voice change; (c) the charting of vocal ranges during specific stages of development; (d) predictability of the voice change; (e) appropriate pedagogical methods for boys during this time of life; (f) appropriate literature for singers during certain stages of development; and (g) social/emotional/psychological factors that contribute to a student's singing success during the normal mutational process.

The few existing empirical studies regarding vocal agility and its connection with the boy's changing voice was reviewed along with existing literature concerning voice studio expert opinions about vocal agility. The need for further research in the area of vocal agility in the changing voice as stated in existing literature will be addressed.

In addition, information regarding the female adolescent voice change intermingles with the literature for males. In more recent years, more studies have been undertaken regarding the female voice change as separate and different from the boys'. Although the literature often intermingles the information of both genders, this review will concentrate primarily upon the male's vocal maturation.

Philosophies of Voice Use During Mutation

Many of the standards and procedures practiced with American choirs come from the European choral tradition. Boys were valued as singers of soprano and alto parts in

choirs of Christian Churches. In the 1500's, Choir Schools for boys were set up in Italy for the improvement of singing in church services. They were "conservatories" or orphanages for girls and boys (named from the Italian *conservatorio*). Charles Burney presented a plan for such schools in England in 1774, and finally in 1822 the Royal Academy of Music was established in England as a boarding school for children. The famous Royal College of Music was established in 1873 (Abeles, Hoffer, & Klotman, 1995). The establishment of boarding schools for boys in Great Britain are especially important to the study of the changing voice because of the great debate which continues among teachers of singing in the Western World. These schools provided opportunities for boys to receive a free education while they sang soprano and alto with the male choirs, but it became practice for the boys to be dismissed from singing when they reached an age when their former high pitches were unreliable. It was said that their voices "broke" and the boys were asked to leave the choir until their voices matured (Cooper, 1964). The practice continued into the twentieth century in the choir schools of Europe. "The general consensus of public school music masters and cathedral choirmasters [in Great Britain] seemed to be that the boy's voice was useless from the time the 'break' occurred until he became mature. The director of the Vienna Boys' Choir expressed the same opinion. . . . What of the future? At the moment it must reluctantly be concluded that in Britain, except for isolated instances, boys' voices are unused during the changing period." (1964, pp. 119-120)

An interesting look into the beliefs and philosophies of choral musicians from past centuries was undertaken by Gustafson (1956) cited letters of response from 20 choirmasters at Choirschools and Churches in Europe, Canada, and the United States (pp.

13-19). In discussing these responses, Gustafson states that the responses from choirmasters, "may be divided into two groups: (a) those that infer that a rest is beneficial to boys in the changing period, and (b) those that indicate that better quality performances can be achieved by using groups other than those which include boys of the changing period." (pp. 18-19). The colorful answer in Gustafson's letter from George Faxon, organist and choirmaster, Trinity Church, Boston, and Head of the Organ Department, New England Conservatory of Music, December 28, 1954, is often quoted in other literature,

> Often real damage is done the voice through extensive forcing and use during this period. The boy talks during this period—and he can attempt to sing for his own amusement and interest—but to attempt to train a new and growing vocal apparatus is obviously foolish and real advanced teachers of voice all concur in this. The 'choral directors' and teachers of music in the public schools are forced to use this voice for their group singing and so they have a different attitude. However, few, if any of these people really know anything about singing for if they really did they would get out of the field of public school music in a hurry and either sing successfully or teach voice. (p. 17)

Controversy about whether or not boys should sing during voice change has continued to exist among American teachers of singing. Brodnitz (1983) reported, "It is already over 100 years ago that an interesting discussion of this topic took place between Manuel Garcia, the first user of the laryngeal mirror, and Dr. Morel Mackenzie, who is now regarded as being the father of laryngology in the English speaking countries. While Mackenzie saw no reason why singing should not be continued, Garcia felt that the premature end of his operatic career was probably caused by a too-early start of professional training of his not-quite-formed voice (Brotnitz, 1983).

In the twentieth century, four researchers stood out as pioneers of the study of male vocal mutation. They believed that singing and voice training during mutation was

desirable. These pioneers wrote about practical methods in teaching boys to sing during the voice change. Their work in identifying and charting vocal ranges contributed greatly to the body of knowledge concerning adolescent male voices. The vocal range charts of Duncan McKenzie (1956), Irvin Cooper (1953), Frederick Swanson (1961), and John M. Cooksey (1977) are discussed below.

Identifying and Charting Vocal Ranges

The advent of the junior high schools during the early 1900's in the United States (Briggs, 1920) began a series of events that were especially notable in the field of the study of changing voices. Once the pubescent and early adolescent boy and girl singers were placed in a separate school building from the unchanged voice singers in elementary schools, and the changed voice singers in high schools, specialists began to develop educational theories that were appropriate for this "middle" or "junior" student. Teachers of exemplary choral programs in schools were sought to share their methods. Two early pioneers of teaching boys to sing during normal vocal mutation emerged during the earlier decades of the American junior high schools. Duncan McKenzie and Irvin Cooper were esteemed leaders in the field of choral music in the junior high schools. A few years later, Frederick Swanson and John Cooksey joined the ranks of pioneers in research and pedagogy for the male changing voice.

McKenzie was a vocal music pioneer who combined the successes of many educators as he laid out his theory of teaching the boy's changing voice (1956). The identification of the term "alto-tenor" as a specific range for the changing voice was not coined by McKenzie, but was introduced in print and discussed in his respected book, *Training the Boy's Changing Voice* (1956). Although McKenzie often has been credited

with the alto-tenor terminology and concept, he cited the *Hollis Dann Song Series Conductor's Book: A Guide to Choral Song Interpretation* (Dann, 1936) as an earlier example of the use of the term "alto-tenor" in American music education (Dann, 1936, p. 101). References to the changing voice as "alto-tenor" were also used by Mursell and Glenn (1938).

McKenzie also observed choirs and choral teachers in America and New Zealand. His theory for teaching the AVC singer was compiled from his own experience as a teacher and from the study of the range approach in choral textbooks for the junior high level boy. McKenzie's theory included the belief that the boys' voices gradually moved downward in pitch throughout the mutation process. He believed that singing during the change was not harmful. He advocated appropriate vocal training for boys.

One of McKenzie's techniques included a "yodeling" procedure for the young bass. This procedure involved exercising with vocalises, using the boys' changing lower notes and falsetto notes. This procedure was to enable the singer to become accustomed to moving back and forth between registers whenever the singing range demanded higher notes that he could not yet reach in his modal (chest) register (pp. 40-41). McKenzie's primary belief was that boys should sing in ranges comfortable for them. He also warned against keeping boys in a classification or voice part in the choir if the boy becomes uncomfortable (p. 35).

Two sets of vocal ranges for adolescent boys were published by McKenzie: one range chart for those in unchanged and changing stages, and one chart for "boy basses" that included ranges for grades seven through nine (p. 30), and high school (grades 10-12) ranges for low bass, bass, baritone, and high baritone (p. 32). His range charts were

meant to be approximations or averages, as McKenzie was well aware of the variability of individual voices (Appendix A).

Although the observation about vocal ranges changing during a boy's early adolescent maturation was common, it was Irvin Cooper who first brought a popular procedure of identifying vocal ranges to music educators in North America. The literature written about him (Cooksey, 1977; Collins, 1981) chronicled Cooper's ability to quickly and easily diagnose ranges in such a way that protected the feelings of the boy, and the teacher's valuable rehearsal schedule at the same. Cooper was trained in Europe, then immigrated to Montreal and became a Supervisor of Music there.

> In the 1940's vocal teachers did not believe a male adolescent could sing during vocal mutation. The practice of 'giving the voice a vacation' during puberty still prevails in many countries today. As Cooper visited the junior high school vocal music classes, he would always find a group of boys sitting in the back of the room enduring a study period while the girls 'melodized away.' Understanding the boychoir tradition since the demise of the castrati, Cooper realized that their voices were changing and it was not vocally healthy for them to 'partake of the sensuous sounds of song' during these most fragile years. In other words, he accepted the fact that they were not supposed to sing. (Collins, 1981, p.2)

Cooper revised his teaching strategies after receiving insight about how changing voice boys could sing around a campfire during scouting excursions. It occurred to him that they could sing in tune if they were able to choose where the song was pitched (Collins, 1981). He was known for his classroom technique in which he would ask the entire section of boys to sing the refrain of "Jingle Bells" by Pierpont. He then tapped the boys on the shoulder whose ranges indicated that they were in the changing voice categories (1953). Cooper coined the term "cambiata" to refer to the changing voice. He charted voices in this developmental period into five groups: girl sopranos; boy sopranos; cambiate; baritones; and basses (rare) [Appendix A]. Cooper and Kuersteiner (1965) said:

> It is a gross error to assume that every voice in each category fits the prescribed range boundaries, but it is safe to say that the ranges apply in ninety percent of the cases studied. Some girls, for instance, can sing higher and lower than the range defined above [see Table 6]; while a number of boys passing through the first change do not realize the upper portion of their range until stimulated to do so. Similarly, boys passing through the second phase of the change gradually realize their lowest note, B-flat, over a period of a few weeks. (Cooper & Kuersteiner, 1965, (pp.15-16)

Cooper was credited with holding workshops and choir clinics throughout the United States during the 1940's and 1950's. Cooper's student, Corisande Auburn (1953), chronicled Cooper's trek through the states of Florida, New Hampshire, New York, Pennsylvania, Tennessee, Texas, Vermont, Virginia, and West Virginia, in a Master's Thesis written at Florida State University where Cooper was a Professor of Music Education. Auburn provided historical information of Cooper's work in clinics with over 1900 students from 1948 until 1953. It was probably in keeping with the cultural norms of these times that student numbers were reported separately as "white" or "negro" (pp. 10-11), Auburn surveyed the music teachers and supervisors who attended these clinics. Responses included information about the vocal ranges of the students from their respective schools, their perception of the final balance of parts (soprano I & II, changing voice, and baritone), the reaction of their boy students to the clinic, report of any "carry-over" into the school after the clinic, and satisfaction with choral music materials currently published for junior high (p. 18). Auburn reported that some supervisors attending Cooper's clinics then began using Cooper's published materials for junior high. At this time, he had published *Unison Songs for Teen Age Boys* (1949), and *Tunetime for Teentime* (1952). Additionally, Cooper's philosophy and method had been published in the *Music Educators Journal*, (1950). In this article Cooper suggested the use of new terminology for the voice change:

> The author prefers to refer to the boy's changing voice as *Cambiata (nota cambiata*—changing note) rather than 'alto-tenor.' There is a definite reason for this identification mark. Many textbooks have acknowledged the incidence of the changing voice in Junior High School, and 'alto-tenor' has become associated with a vocal range extending from F below middle C upwards an interval of a sixth or seventh, whereas, the *cambiata* extends upwards to octave middle C. Admittedly the upper fifth of this range frequently holds some soprano quality, but it is still part of the voice and is available for use. (p. 21)

Additionally in this article, Cooper spoke about the vocal "sluggish" articulation of AVC males:

> Another factor must be considered in selecting music for Junior High choirs or classes, namely, the relatively sluggish articulation of these newly acquired voices in the boys' section…The *cambiata* part should be filled with interest and used often as the melody part, for it has a beautiful tone quality, full of vigor yet capable of exquisitie *pianissimo* singing. Quickly moving melodies are not advocated.
>
> Baritone parts should be slow-moving, using interval leaps of fourths and fifths with intervening short scale figures. (p. 21)

Following Cooper, the continuing interest in choral music in junior high schools in America fostered the leadership of another pioneer in changing voice theory, Frederick Swanson. Swanson wrote books and articles about the changing voice during the 1960s and following decades. His work reflected the philosophy that boys and girls should continue to be taught sound vocal production during the voice change (1981); that boys separated from girls in the school chorus could better achieve in singing ability (1960, 1977); that males could be enthusiastic about singing if they were taught well (1984); and that the tessitura of the vocal repertoire was of paramount importance to singing success (1961). Swanson has been especially noted for his work with the adolescent bass (1961). He wrote:

> There is really only one problem that differentiates the young male singer with the changing voice from other singers: range. The young adolescent is adding tones down in the bass clef. Therefore, that is where he must sing, and he must develop these newly emerging tones properly. Assuming he has not lost his voice entirely

> so that he can neither speak nor sing (voice change is not the cause for such dysfunction), one can easily find out what tones the youth can produce, and that is where one begins. As additional pitches are added to the developing range, the material to be vocalised and sung can be adjusted. (1981, p. 32)

Five general patterns of voice change were charted by Swanson (1981; see Appendix A). His "Pattern One" was said to be most frequent. This pattern consisted of voices whose tones in the bass clef emerge quickly while the treble tones continue to function. "The singer can use his baritone voice for a while, then shift into the treble voice with surprising, even amusing, effect" (p. 33). "Pattern Two" consisted of voices where puberty is rapid. Swanson described this poorly understood group of boys as "neglected, discarded, wasted, lost singers." This pattern occurred when the voice dropped "almost overnight into the deepest regions of the bass clef; the treble tones disappear" (p. 33). "Pattern Three" was said to be similar to the first pattern, except that the tones in the middle disappeared (p. 34). "Pattern Four" was described as the pattern where the voice drops slowly from soprano to alto to tenor, seldom with problems in the *passaggio* (p. 34). The final "Pattern Five," described as rare, happened when the voice "dropped five or six tones, stays at that level for as long as a semester, suddenly drops five or six more tones, then levels off for a longer period of time, drops a bit more, etc." (p. 34).

In 1977-78, a landmark study by John Cooksey was published. His research into pubescent and early adolescent voice change led to his "Contemporary, Eclectic Theory." This theory included range charts for five stages of AVC. Cooksey also described principal features of each speaking and singing voice stage:

> Stage I. Beginning of Mutation
> Principal Feature: Lowering of the *Upper* limit of range. . . .
> Stage II. Highpoint of Mutation

> Principal Feature: Narrowing of the Singing Range. . . .
>
> Stage III. End of Mutation
>
> Principal Feature: Lowering of the Lower Limit of the Singing Range. . . . (pp. 9,10)
>
> Stage IV. Postmutational Period
>
> End of the most dramatic stage of pubertal development. . . . .Adult sound still not fully apparent. . . . The quality is a bit difficult to describe. The childlike-soprano qualities are gone, but the fully developed adult sound is not yet present. Resonation capabilities in the lower regiater extremes are not yet fully realized; thus, the power and intensity in notes below B flat (2^{nd} line, bass clef) must still be developed. The voice remains light, but approximates the mid-baritone sound. . . . Finally, the vocal agility is somewhat limited in Stage IV. These newly changed voices may have difficulties in negotiating fast moving intervallic leaps of more than a 4^{th} or 5^{th}.
>
> Stage V. Early Adult Phase
>
> Body and reasonance of the tone increases, and characteristic adult qualities emerge. Voice classification is easier to determine, and there is a general expansion of range capacity if the proper training is administered. If the voice is destined to become tenor, some of its lower notes may disappear. The vocal instrument is 'ripe for private voice instruction.' Vocal agility, resonance, and power increases significantly. (p. 14)

Cooksey's results modified the voice change stages in previous theories by Cooper, Swanson, and McKenzie. Although Cooksey noted differences among the theories, he also noted *agreement* of philosophy among these three pioneers in these areas:

1. the onset of puberty with development of primary and secondary sexual characteristics occurs at the time of voice change.
2. the need exists for more adequate published vocal literature for range and tessitura for boys of this age.
3. singing is unpredictable, and vocal control is difficult for boys who are forced to sing in the wrong pitch range due to the irregular growth rates in the larynx and throat.
4. many differing growth stages can be found in groups of boys between ages 12 and 15.
5. there are varying rates of voice change among individuals.
6. it is necessary to administer range tests of individual boys as well as the group or choral section.
7. teachers should explain the voice change process to students, and help them understand what is happening to them during this time, and
8. teachers should help boys establish good singing habits. (p. 8)

Cooksey's range charts included five stages or classifications of changing voice: Stage I, Early mutation, Midvoice I (beginning of change); Stage II, High mutation, Midvoice II (middle of change); Stage III, Mutation climax, Midvoice IIA (climax of change); Stage IV, Post-mutation Stabilization, New Baritone (tapering period) Stage IV, Post-mutation Settling Baritone (expansion/development) (2000, p. 499). His 1977b range charts were slightly modified as his research progressed (p. 502-503). The nomenclature for stages IV and V was revised to "Newvoice" and "Emerging Adult voice (p. 590)" (Appendix A).

Important longitudinal research was undertaken by Cooksey, Beckett, and Wiseman in a 3-year study begun in 1978 in California ($N = 86$). Although this research was not published in its entirety, Cooksey shared it at a Research Symposium in 1983. His eclectic theory included the idea that all boys progress through all five stages of voice change in a predictable way, stating:

> All normally healthy boys pass through the five stages of voice mutation in a 100% predictable sequence. Taken together, five pubertal growth spurts produce the five-stage phenomenon we call male adolescent voice transformation. In each person, each stage lasts for a different amount of time, and the time spans of each growth-to-stabilization cycle are highly varied between individuals. (2000, p. 823)

Vocal Phenomena during Voice Change

The work of the earlier pioneers and the need for a better understanding of the characteristic phenomena during voice change spurred the interest of a number of researchers to try to answer many of the questions that remained about AVC. Joseph (1966, 1969), Richison (1971), Groom (1979), Rutkowski (1985), Collins (1987), and Killian (1997, 1999) were among the researchers of the latter half of the twentieth century who sought answers to questions surrounding the vocal change phenomena.

Studies by Joseph (1966) found a physiological basis for establishing norms and LTP (Lowest Terminal Pitch) through comparisons of school biological measurements and simple singing tests. He continued charting speaking and singing limits of the voices and noted gaps and isolated harmonics in the singing ranges, "Very often, the uncertainty of vocal production which was characterized by lack of flexibility or gaps of an octave or more in the producible range occurred." (p. 426)

Singing ranges continued to be a measurable area of interest among researchers of changing voice phenomena. Richison (1971) analyzed vocal maturational patterns in a longitudinal study, and spoke of ranges existing in "plateaux." He found two patterns of voice change: sudden and gradual, from highest pitch of one plateau to the second plateau. "All males changed suddenly from a second plateau to a third plateau" (p. 99). He spoke of the emerging baritone voice "described as an alto-tenor with neither alto quality nor tenor range" and explained that "Baritones remain at a third plateau within two years after attaining a third plateau…A peak in breathy, husky voice quality is reached at the second plateau." (p. 99)

The work of Cooksey (1977) inspired the continued testing of ranges and other characteristics of the adolescent boy's changing voice for many researchers. Groom (1979) used Cooksey's findings as a basis for completing a descriptive study spanning five months, during which boys' voices were measured for range, key preference, dynamic flexibility, and agility. After first classifying participants into one of five stages identified by Cooksey (1977b), simple musical patterns and melodies were recorded and judged. Groom compared the measurements from the spring of one school year to the fall of the next school year when the participants returned after the summer vacation. Her

findings indicated that there were "blank spots" usually in the middle of their ranges, and a "break" or difficulty controlling the voice at register shifts. She also noted the tendency of students to modulate downward to a more comfortable key rather than the pitch given them by the researcher. This phenomenon was also observed in Cooper's initial investigations as reported by Collins (1981). Groom concluded that gradual lowering of pitch as well as sudden changes were apparent in her subjects, a significant correlation between physical growth and voice lowering was apparent. HTP or high terminal pitches have great variability, and blank spots may be present in the midrange of some boys.

Connections among disciplines of educational research, psychological research, and medical research continued to be made. In the field of adolescent health care, Lee (1980) performed medical examinations on 36 males and 18 females in Great Britain from 1969 to 1974. He called the onset of voice change "voice break," and the settling stage "voice change." His charts noted that the mean "voice break" was measured at 13.5 years, and the "voice change" mean was 14.1 years (p. 27). He continued to say, however, that the sequence of events in the mutational process varies considerably from individual to individual (p. 29).

In the continued search for information, the need for longitudinal studies into the process of voice change became apparent. Rutkowski (1985) reported results of a longitudinal study using Cooksey's voice change theory. Her study with 23 boys in grades 6, 7, and 8 established vocal range for each subject using the common method of listening to the speaking voice first, then listening to the boy sing 5-note diatonic patterns progressing chromatically until the highest and lowest terminal pitches were established. She found that the subjects did indeed follow the vocal stage progression found by

Cooksey (1977b). Her three-year participation by same subjects also afforded the observation that the boys seemed to take an interest in their own progress, "initially reluctant to sing, exhibited eagerness and interest in singing in order to determine their vocal development since the previous testing session" (p. 9). Her findings in this area were similar to those of Joseph (1969), who speculated that progress in measuring HTP may be "that the range extensions at the upper extremes can also be accounted for in part by the interest that the subjects took in their own individual ranges" (p.426).

The work of Cooper and McKenzie continued to inspire later researchers and pedagogues. Often, the philosophical underpinnings of each of these pioneers took the form of a debate among educators about which method was better. Collins has been a fierce advocate of the Irvin Cooper method. His work has included the foundation of a publishing company (The Cambiata Press) and subsequent website (www.cambiatapress.com) espousing Cooper's cambiata method of teaching boys during AVC. In addition, Collins has published books and articles in other venues.

One of the many isolated voice characteristics of the AVC mentioned by Collins (1987) is the observation of the heredity factor. "Boys in the northern part of the United States tend to change somewhat later than those in the South. There is a question as to whether climate or heredity is the primary factor (p. 13). He postulated that families of differing ethnic backgrounds have settled in different parts of the United States, therefore giving credence to the appearance of an earlier voice change for boys in particular American cities as a factor of heredity rather than climate. This heredity theory is supported by Hughes (1984), in her measurement of the onset of voice change between white and nonwhite adolescent males of the same age. Her nonwhite students were

limited to African American students at schools in Tuscaloosa, Alabama. She tested ranges of white and nonwhite students, concluding that "nonwhite adolescent males matured vocally at an earlier age than the white adolescent males. At each level of vocal maturation the nonwhite subjects entered the subsequent level . . . in higher percentages than their white adolescent male counterparts" (p. 65).

The phenomena of the voice change has been explored in an interesting way by Killian (1997) in her research about perceptions of the voice change by boys who were currently experiencing this mutation, and the perceptions of men as they remembered their own voice change process. Killian questioned boys and men who were in two groups, musicians or non-musicians. She found that "boys had a significantly more vivid memory of their voice change than did men. Singers' memories were significantly more vivid than nonsingers'. . . more singers noticed their voice change themselves than did nonsingers. . . . Boys mentioned voice pain or thinking they were ill at onset of voice change significantly more often than did men" (p. 526). The males' perception of female reaction to their changing voices was also questioned. "Subjects frequently mentioned that girls and women were more likely to pay attention to them after their voices changed" (p. 533).

In another study, Killian (1999) explored the longitudinal changes of range charts as the decades have progressed. She found that the onset of voice change was occurring earlier than it did a few decades ago. Using Cooksey's (1977) range stage charts, Killian tested subjects in grades five and six. Results suggested that the voices were changing earlier in life than they did in 1977.

In summary of the voice change phenomena studied in the second half of the twentieth century: Joseph (1966) found a physiological basis for establishing norms and LTP (Lowest Terminal Pitch) through comparisons of school biological measurements and simple singing tests. He charted speaking and singing limits of the voices and noted gaps and isolated harmonics in the singing ranges. Richison (1971) analyzed vocal maturational patterns in a longitudinal study, and spoke of ranges existing in "plateaux." Cooksey (1977) charted five ranges stages and other characteristics of the adolescent boy's changing voice. Groom (1979) used Cooksey's findings as a basis for measuring range, key preference, dynamic flexibility, and agility. Lee (1980) performed medical examinations on 36 males and 18 females from 1969 to 1974. He called the onset of voice change "voice break," and the settling stage "voice change." Rutkowski (1985) reported results of a longitudinal study using Cooksey's voice change stage theory. She found that the subjects followed the vocal stage progression found by Cooksey (1977b). Collins (1987) observed the heredity factor in male adolescent voice change, finding that boys residing in the northern United States tended to experience voice change at a later age than did boys in the southern United States. Killian (1997) studied perceptions of the voice change by boys as compared with perceptions of men as they remembered their voice change process. Killian (1999) also found that boys' voices were changing at an earlier age than they did when Cooksey (1977) initially classified boys into five range stages.

Predictability of Voice Change

Predicting the onset of voice change, the pattern that it takes, and the voice development following this mutational period has interested many music educators and

researchers. Ekstrom (1959) measured vocal characteristics and compared male voices before, during, and after mutation within a three-year period. His subjects were first tape-recorded, then the recordings were played through an oscilloscope which translated sound waves into graphed wavelengths. In the predictability portion of his study, he found that 58% of prepubescent male first sopranos became tenors following AVC, 20% became baritones, and 22% became basses; 47% of 2nd sopranos became baritones, 24% became tenors, and 22% became basses; 60% of altos became basses, 19% became tenors, and 21% become baritones.

The decade of the 1960's brought more scientific measures to the study of the AVC. Joseph (1965) began a longitudinal study of the occurrence and predictability of voice change. He studied and cited many biological studies pointing toward the connection between the emergence of primary and secondary sexual characteristics and the voice change in the male. As voice change is also considered to be one of the secondary sexual characteristics emerging during puberty, Joseph explored the relationship of pubertal change and its relationship to school music programs (1965). He concluded:

> From the various research studies related to charting adolescent development, the following conclusions are eminently supported by respectable scientific data:
> 1. Voice pitch does change as growth occurs.
> 2. Voice pitch deepens progressively during the maturation process.
> 3. The deepening of the voice corresponds to a marked degree with the appearance of the secondary sex characteristics, or is in itself one of the secondary sex characteristics.
> 4. The appearance of the second molars coincides with the appearance of the other secondary sex characteristics, and can thus be employed in charting and understanding vocal growth.
> 5. The deepening of the voice is related to the somatic and endocrine development of the adolescent.

6. Of all the varied factors affecting growth, skeletal development probably correlates most highly with vocal growth, and is therefore the most accurate predictive measure. (Joseph, 1965, p. 93)

Research in the field of speech and phonology has mirrored research in vocal music education. Although the testing commonly involved speaking voices rather than singing voices, there are similarities that have been investigated. One of the researchers who made connections between the two disciplines is Hollien (1978), who summed up his, and colleagues, research to date concerning the issue of predictability associated with. The symposium included presentations from experts in the field of phonology and audiology. Hollien's summation was that it was not known if AVC measures correlate closely enough with pubescence to be useful as a predictive tool. He did however, state that:

1. some boys enter AVC and presumably the pubescent period as early at 10 or 11 years;
2. most boys have entered the adolescent period by 14.5 years;
3. voice change correlates reasonably well with other parameters related to such change;
4. most males have completed the AVC process by 18-years of age;
5. the greatest changes usually occur during the period, between 12 and 6 years;
6. while girls probably precede boys through puberty by a year of so, the changes associated with their pubescent period are much more gradual as those immediately before, during and immediately after this period;
7. boys, at least, show increased phonational frequency ranges during puberty; and
8. gread [sic] individual variability occurs in AVC, and presumably puberty itself, with respect to both onset and duration. (pp. 40-41)

Hollien (1978) also concluded that prepubescent boy larynxes are on average smaller than are the girls' at that childhood stage, resulting in higher pitch capabilities. (p. 37)

On the other hand, predictability of future adult voice classification has been

discussed among choral music teachers for many years. According to Cooksey (2000), there is no scientific evidence suggesting that the classifications such as "tenor" or "baritone" or "bass" could have been predicted by voice change experiences. As Cooksey wrote:

> Does the rate of voice change determine what the mature adult voice classification will be? If voices change slowly, will a tenor classification result? Does rapid change signal the likelihood of a bass classification?
>
> Thus far, there is no research to provide answers to this question. Some theorists *speculate* that voices that are transforming rapidly are destined to become basses, while those with slow growth rates and later onset of change will become tenors. (Cooksey, 2000, p. 594)

Pedagogical Methods for Boys during Voice Change

There is a good reason why literature has been abundant in advice for teachers of pubescent and early adolescent singers. Teachers have found themselves ill-prepared for the wide variations of the mutational voice. As some educators succeed in this area, they often write about their ideas, their successes with changing voice, and even their action research. Authors of handbooks and guides written before 1960, often quoted by researchers, include (chronologically): Stubbs (1888), Dawson (1902, 1919), Rix (1910), Johnson (1935), Pitts (1935), Breach (1936), Mellalieu (1935), Gehrkens (1947), Rorke (1947), Nordholm and Bakewell (1953), Jacques (1953), Andrews and Leeder (1953), Cooper (1953), Dykema and Cundiff (1955), McKenzie (1956), and Sur (1958).

Since 1960, experts have continued to advise about appropriate voice parts for the pubescent/early adolescent male singer in books and professional journals written to aid music teachers. Mayer and Sacher (1964) wrote instructions for teachers in an article published in two consecutive issues. They were convinced that the male voice change was not abrupt, that these voices were capable of wider ranges than was currently

thought, and that current research was "dependent upon individual preferences" and contrary to their views (p. 8). They believed that problems for the boys were created by insisting boys sing alto only after the change had commenced. They also believed that teachers could avoid vocal problems in their vocal changing male students if they limited vocal intensity and endurance (p. 10).

Inspired by the philosophy of Swanson, Busch (1973) wrote that boys should be singing in a choral section with other boys of changing voices during this period. He disagreed with those who placed those singers in the soprano section, saying "There are boys choirs and mixed choirs with male sopranos entering voice change who still can sing with a strong, clear, unchanged voice, but just because they can do it is no indication that it is the proper thing. . ." (p. 21).

The questions of how to group singers have been addressed in the literature. Siltman (1978) wrote a series of three articles with practical hints and philosophies about male adolescent voices. His approach was to keep all students of varying abilities in the same choir so that the faster-achieving students could support the weaker students. He also espoused using performances to fit the students' needs, saying, "Make choruses out of singers rather than making singers fit into choirs. (p. 10). Cox (1998) indicated that the procedure of scheduling genders separately greatly reduced the fear boys had of singing in front of the girls while their voices were in a vulnerable state. Additionally, she advocated placing girls and boys in separate classes during the AVC (Hook, 1998; Kennedy, 2004).

Following the earlier pedagogical advice of McKenzie (1953), a later pioneer and pedagogical leader, Swanson (1960), addressed the comfort issue of singing ranges. He

indicated that boys should sing in ranges that are comfortable for them. After a one-year action research project in his own junior high school, Swanson's advice to teachers included separating the boys in classes according to their physical maturity (alternating classes with the boys' physical education teacher) and working with those who were in a more homogeneous maturational group (pp. 50 & 53). In another article, Swanson (1961), a leader in research of low bass parts and the fry register, humorously said:

> Rare is the high school where all students must participate in the music program. Therefore, the finger is on the teacher of junior high music, for here is where our potential basses can be won or lost. The difficulty is that just when the human male is getting ready to sing bass he is the most awkward, raucous, recalcitrant, and unteachable material in all the educational workshops. (p. 63)

Swanson (1977) also proposed segregating boys from the girls in singing classes. He reported that spectacular results were possible if boys at this age level were guided properly. Later, Swanson (1981) spoke of his experiences in studio teaching of boys during the vocal maturational stage. He encouraged studio teachers to accept these students because this time of rapid change was important to establish good vocal habits. Swanson (1984) wrote that boys had to sing in a new idiom during and after the mutational process. His concern was, "How often we hear an adult [male] say, 'I used to be a pretty good singer when I was a kid, but then something happened and my voice went bad, so I don't sing anymore.(p. 47)'" Swanson continued to implore teachers to teach boys how to use their new voices.

The comfort issue raised by the previously-mentioned authors has manifested itself in emotional as well as physiological ways. Metz (1980) included information in his choral methods book about the normal voice change. He stated, "Some voices seem to change overnight (or over summer vacation), while others change gradually."(p. 54)

He suggested that teachers should be aware of changes and adjust demands placed on these singers. A follower of Cooper's philosophy, Metz advised careful handling of these singers as necessary to keep them involved. (p. 54)

The goal of retention of male singers in American schools has received much attention. Castelli (1986) surveyed students, administrators, and teachers in public schools to ascertain the reasons why many boys do not continue to sing in secondary schools. He asked questions relating to (a) family opinion, (b) male sex role, (c) the vocational utility of singing, and (d) adolescent voice change. In his survey of the students, he found that 42% of the boy students who did not continue singing indicated that the main reason was associated with voice change.

The Need for Research in Agility in the Changing Voice

Writers and researchers from the past have noticed areas such as vocal agility in the changing voice as a characteristic that has not been fully understood. An early study by Curry (1940), measured speaking pitches in adolescent boys' voices. Curry studied adolescent males in three groups, group I (10-year olds), group II (14-year olds), group III (18-year olds). Although the testing involved speaking rather than singing, informational transfers have been made to singing research. Curry measured speaking range, inflections, and shifts, but the most interesting part of his study for the present study was his measurement of the rate of pitch change in tones per second. Curry discovered that "the monotony of the ten-year-old voices is shown by the fact that the two older groups show nearly twice as rapid a rate of pitch movement as do the subjects of the youngest group" (p. 54). He suggested that variables such as reading ability of the boys might have been a contributing factor.

The need for future research was also made Cooper, as he observed and advised educators about vocal agility in his numerous writings. In his book *Letters to Pat* (1953), he recommended how to write choral music for junior high students:

> The first considerations are, of course, the individual range and desirable tessitura of soprano, cambiata, baritone. . . . Next, and of paramount importance is an understanding of each voice's speed of articulation. . . . Cambiata have a much slower rate of articulation than sopranos, yet their part should be melodious and meaningful. . . . Keep in mind that a voice part does not have to move in eighth notes to be interesting: a judicious use of half notes broken by quarters and very sparsely used eighths is most effective. . . . The baritones, having recently undergone a major vocal change, move quite slowly at first. Their part must emphasize tonic and dominant pedal points, then move stepwise in broad scale patterns. (p. 35)

Characteristic differences among boys were rated by Ekstrom (1959), in his study comparing boys' voices before, during, and following AVC. He recorded boys (*N*=213) at regular intervals from 1954 to 1957, comparing flexibility, agility, range, breaks, tessitura, and voice quality of male voices before, during, and following AVC. His group of "before" voices were boys in the unchanged voice classification. The group of "during" consisted of boys in a classification as close to the alto-tenor classification as possible. The group of "after" voices was a group of changed voices with the LTP of a B-flat or lower (pp. 178-179). In addition to Ekstrom's aforementioned conclusions about voice part predictability, his three judges rated agility as "V" for very agile, "M" for moderately agile, and "N" for not agile. A very agile singer was defined as a boy who was capable of singing quickly, with dexterity, a pattern of notes (do-mi-sol-mi-do), then with stepwise motion (do-re-mi-fa-sol-fa-mi-re-do) using the syllable "ah." The "not agile" singer was rated as such if he demonstrated slowness or clumsiness. The "moderate" singer was rated as such if he exhibited what was perceived as moderate ability in the task (p. 10). Ekstrom found that, "If a boy had an agile voice before the

change he more than likely had an agile voice afterwards." (p. 251) In his final statements, he wrote that ". . . better than 98% [of boys continuing choir] had very agile voices at the last recording (p. 192). His overall conclusion was that choir membership improved a boy's agility level. Ekstrom suggested that more research should be done in the field of agility: "Shakespeare has exercises on agility . . ., and Curry describes it [agility] . . ., but the field is wide open for research and the terminology has to be standardized." (p. 56)

In writing about the amount and quality of the repertoire available for junior high school choirs, Taylor (1966) stated that "there is an apparent need for laboratory experiments with adolescent voices in actual musical situations and contexts. From these could be developed more specific illustrations of the practical limits of tempi, specific syllabic problems, and minimal note values suitable for junior high school voices" (p. 104). His concern was that composers of contemporary literature might be better aware of the limitations of these students.

An influential researcher in the field of AVC and prolific writer about ranges and other characteristics, Cooksey (1977) has called for further research to be accomplished in a number of areas. His recommendations for further research included (a) breaking down the physiological and psychological barriers for young male singers, (b) building more scientific information about the voice change, its longevity, its rate of change, and (c) "how it specifically affects vocal range, voice quality, register development, and vocal flexibility and agility." (p.13)

Almost immediately following Cooksey's plea for more research, Groom (1979) determined vocal agility by observation of accuracy in rhythm and pitch (p. 71). Her

results were in agreement with Cooksey's contention that there is a loss of some vocal agility during vocal mutation (pp.108-109). In her 1979 study measuring students before summer break and again following the summer break, Groom assessed vocal agility as "good, fair, or poor" in her first springtime test. She found that out of 40 subjects, 18 were tested to be "good," 8 were "fair," and 14 were "poor" in agility. In the follow-up test after summer break, she found that out of the same 40 subjects, 20 were "good," 12 were "fair," and 8 were "poor." Her conclusions concurred with Cooksey:

> The data in this study show that 74% of the students classified in the B (alto) or C (cambiata) categories had either good or fair ratings with respect to vocal agility. This is in agreement with Cooksey's contention that there is a loss of some vocal agility during vocal mutation. . . . As stated by Cooksey, and evident in this study: "There tends to be more stability and less individual variations in the lower range limits throughout the different stages of voice mutation. In the upper range limits, there is [sic] great variations throughout the first three stages, but this stabilizes dramatically in Stage 4 [Class D] (1977b, p. 15)." (Groom, 1979, pp. 108-111)

The need for more information about agility during AVC has continued to appear throughout the literature concerning repertoire selection for the middle school chorus. Selection of songs that singers of this age can successfully sing is one of the most talked about issues among middle school choral music teachers. In an article about the importance and feasibility of using European Renaissance Madrigal music in middle schools, Butler and Lind (2005) suggested that madrigals are important for the musical development of singers at this age. They recommended that some madrigals are better suited for middle school students than are others. In addition to textual considerations, they indicated that the ranges may need to be rewritten for some changing voice parts. They also addressed rhythmic and harmonic complexities saying:

> Young singers have difficulty negotiating rapidly moving melismatic passages or complicated rhythmic sections. Their vocal mechanisms are simply not equipped

> to handle some of the more challenging aspects associated with this genre. Dotted eighth and sixteenth-note rhythms, running eighth notes, or sharply articulated sixteenth notes will most likely prove problematic and should be avoided. Choosing music that features straightforward harmonics and simple or repetitive rhythms, especially during imitative sections will ensure success. (p. 39)

To summarize, agility during the voice change has been addressed by several authors. Curry (1940), measured the rate of pitch change in adolescent male speaking voices; Cooper (1953), recommended writing music for the slower articulation of changing voice boys; Ekstrom (1959), found that a positive relationship existed between agility and choral experience; Taylor (1966), stated that "practical limits of tempi, syllabic problems, and minimal note values. . . [should be studied] for junior high school voices" (p. 104); Cooksey (1977), observed a loss of some vocal agility during adolescent voice change; and Butler and Lind (2005), recommended avoiding problematic eighth and sixteenth note passages in European Renaissance Madrigals when performed by young adolescents. Many of these authors' recommendations, however, are based on observations made within the context of studies that did not actually include agility within the research design or test for it specifically. The present study was designed to focus on the issue of agility more systematically and with greater precision.

Vocal Agility in Adult Voices

Literature surrounding the importance of agility in singing is evident in books intended for studio voice teachers and their students, written by such respected voice experts as Caldwell (2001), Coffin (1987), Brown (1996), Miller (1986), and Vennard (1967). These writers and studio singing teachers have proposed techniques intended for use in the voice studio, designed to strengthen agility in the voice.

Miller (1986) insisted that complete vocal health for singers is partially dependent on the attainment of good vocal agility, "Agility and sostenuto are opposing poles of vocal proficiency, but both are produced by the same muscle participants" (p. 40). Miller taught that muscle balance consists of alternating muscular movements. He wrote that strength and flexibility need to be balanced by daily practice. "Unless the singer, regardless of vocal classification, is able to negotiate running passages and melismas cleanly, sostenuto passages will lack ease of production." (p. 40)

Joining Miller in the field of writers of textbooks about how to manage the singing voice, Coffin taught that "It is necessary that all voices have agility for highly exciting passages as well as for vocal health" (p. 138). He recommended exercising the ability to perform with great agility, citing the exercise books of the past, written for coloratura training of European singers. He also stated, "The voice simply lasts longer when a balanced 'diet' of agility and sustained tones is taught." (p. 138)

The idea of the skill of vocal agility as a learned behavior has been continued by Caldwell and Wall (2001). They have encouraged daily practice in agility for the adult singer by singing a variety of scales slowly, then increasing the tempo. They addressed the hesitation of many singers when trying to learn fast pitch changes by recommending that they modify the visual aspect of the music (enlarge or rewrite it so that heavily barred 16^{th} or 32^{nd} note passages are not so intimidating), practice slowly, take advantage of motif repetitions, and divide long passages into smaller patterns (p. 505-506).

In addition to the writers advising adult singers on the subject of vocal agility, Brown (1996) offered advice to teachers of adolescents and to the adolescents as they sing through the voice change. He recommended that boys should not force the voice

during voice change, but may continue to sing. "In my own experience, there is no damage done to the young male's voice if he is allowed to sing lightly during the voice change of puberty" (p. 69). He continued with the advice that young voices should not sing too loudly or for too long in one rehearsal (p. 70).

The idea about how a singer must think about singing with agility was addressed by Indik (2002), in his article about a "science of control theory" established during World War II as a model for weapon systems (p. 305). In his transfer to a completely unrelated field, Indik applied that theory to the art of singing. His thoughts addressed an idea that voice teachers have taught for centuries: singers must refrain from trying too hard to make the voice agile in order to be successful with agility. The second part of his article title says, "or, I Could Control Myself If I Could Only Let Go So I Could Control Myself." He used the terms, *corrector* and *predictor* to describe nervous system functions used when singing. As the singer produced an incorrect pitch, his hearing would give feedback to the brain, and an adjustment signal would then be sent to *correct* the pitch. The *predictor* process was the brain's closest estimate of how the vocal mechanism should begin the pitch, and set up the musculature for the correct pitch in advance of its production. Indik wrote about the process of the singer moving the voice between pitches:

> Because the voice may need to move accurately between pitches faster than the time it takes even the 'corrector' to converge on each intended pitch, the system must rely mainly on the 'predictor' to guide the voice. . . . The predictor is entirely responsible for the first attempt at a note the singer sings after a rest. . . . When there is less time, as notes are flying by and the singer is moving from note to note, the singer is constrained by the inertia of the previous moment and lack of time to intervene consciously. . . . The quantity of time, the 'total error correction response time,' is a crucial value in the feedback process of singing and figures strongly in any mathematical modeling of the control system. (p. 311)

Agility and the Vocal Mechanism

Because the vocal instrument is a hidden biological instrument which cannot be examined or manipulated like a flute, oboe, or trumpet, singing teachers have been at a disadvantage for centuries in describing how the vocal mechanism really works. The art of teaching singing since the early Italians has been somewhat separated from the science of the singing voice until the twentieth century. However, many of the long-trusted methods of using analogies in describing how singing should feel have been gradually substantiated in scientific research. Science researchers in fields of study other than the fine arts have sought answers to how the vocal mechanism actually works partly from scientific curiosity, but also because of the search of how voice disorders could be prevented. Voice teachers and choral musicians who have dealt with adolescent voices have been particularly interested in how to approach singing in such as way that no physical damage could be done (Adler, 1999; Andrews, 1988; Blatt, 1983; Brodnitz, 1978; Chapman, 1989; Cooksey, 1977; Herman, 1988; Perkins, 1978; Phillips, 1996; Titze, 1993; Welch & White, 1993).

The understanding of scientific information has also been beneficial in the study of how the laryngeal musculature relates to agility in the voice. Kob (2002) studied the biomechanical workings of the voice, which included the building of a robotic type machine that mimicked the larynx and surrounding vocal mechanism.

In a study of maximal speed of voice pitch change, Sundberg (1979) measured the speed of ten untrained (5 male, 5 female) and ten trained adult singers (5 male, 5 female). Subjects sang alternating pitches as rhythmically and quickly as they possibly could. The researcher signaled the tempo with hand signals, audio clicks in ear phones, or flashes of

light. Each pitch change in varying melodic intervals was repeated eight times. Sundberg found that the trained singers changed pitch more quickly than untrained singers, and female subjects changed pitch more quickly than male subjects. In addition, the untrained singers negotiated drops in pitch (descending pitches) faster than elevations in pitch (ascending pitches).

Sundberg (1987) reported that most measures of the subglottic pressure of singers have concerned sustained phonation. He pointed out that subglottic pressure, "is a rapidly varying parameter and often changes between adjacent notes." (pp. 36-37) He reasoned that the variation is because the subglottal pressure must adapt to both loudness and phonation frequency. He wrote that in singing fast passages, there is a continuous pulsation of the subglottal pressure that must be synchronized with the phonation frequency. Because tempo in a rapid passage of pitches is as fast as 7 notes per second, the changes in subglottic pressure must be quick. Sundberg also wrote that voice disorders sometimes appear in the male mutational voice. As the boy wants to use the new pitches available because of increased laryngeal dimensions, he may find that the vocal folds fail to close the middle of the glottis assumed to be caused by an insufficient activation of the vocal muscles. Therefore, *phonastenia*, or vocal fatigue, may occur. Symptoms of *phonastenia* include tiredness in the throat, sensations of a lump, pain, or burning, and/or increase of the natural secretions which in turn create a need for repeated clearing of the throat (p. 183).

Other evidence of scientific measurement of the voice change as it has pertained to air flow and phonation has been offered by Twitchell (1985). Investigating the respiration and phonatory measures in adolescent males, she found that male adolescents

displayed high air flow rate, higher than normal limits of the ratio of phonation volume to vital capacity, and a shortened phonation time. She believed that these measures reflected normal laryngeal readjustments related to pubertal voice change.

In reference to the musculature involved with the ability to sing with agility, Brown (1996) spoke of the biological mechanism related to agility in the singing voice. He reminded that the laryngeal muscles are miniscule and hidden, and care must be taken in younger voices. He also contended, however, that "singers must train like all athletes to establish kinesthetic responses" (p. 71), and continued:

> When a muscle is used, it takes a fraction of a second for it to recover. During strenuous exercise, a muscle could be temporarily unable to respond to the next nerve impulse because it didn't have enough time to get the oxygen required to counteract the amount of lactic acid formed during use. Tension could be the culprit that prevents that new impulse from getting through. This is one of the reasons that coloratura is so valuable in voice training. The voice moves from note to note quickly, activating new muscle fibers and releasing others. This allows for an exchange of oxygen without a buildup of fatigue. At the same time, you are exercising a range of impulses that activate many muscle fibers and therefore contribute to their growth and responsiveness. Coloratura conditions reflexive action in the muscles. (p. 73)

Brown cautioned about differences between adult and young voices, pointing out that the lung pressure (sub-glottal) is greater in proportion to the size of the larynx in younger people than in adults.

In a report given by Thurman, Welch, Theimer, and Klitzke (2004), scientifically-based information about the singing voice (primarily vocal registers) included statements by Cooksey regarding pubescent voice transformation. As vocal folds length and thicken, and as there is an increase in the dimensions of the trachea during pubescent male voice change, the coordination for upper and lower registers continues in boys who have had appropriate vocal instruction prior to the voice change. "Typically, those

experiences instantiate in vocal neural networks a 'template coordination' for blended register transitions that only require modifications during the laryngeal growth spurts of adolescent voice transformation" (Thurman, Welch, Theimer, & Klitzke, 2004, Register Transitions, ¶15). The Thurman group also reported that laryngeal muscles are capable of extensive, vigorous use, high agility, and resistant to fatigue when they are conditioned and operating at optimum efficiency (Thurman, Welch, Theimer, & Klitzke, 2004, Register Transitions, ¶ 6).

As Cooksey (1997) reported using his updated terminology for voice stages:

> Unchanged Voices . . . Vocal Agility. Very flexible, agile capability with good capability for intensity variation (p. 602). . . .
>
> Midvoice I Classification . . . Vocal agility. Not as flexible or agile in upper range because the size of laryngeal structures is beginning to increase (p. 602). . . .
>
> Midvoice II Classification . . . Agility. Midvoice IIs are not as agile when compared to unchanged voices. Avoiding their upper pitch range (the most unstable part of their range), will help them avoid learning unnecessary vocal effort in their singing. (p. 604). . . .
>
> Midvoice IIA Classification . . . Agility. Presumably, the vocal folds of many Midvoice IIA singers become stiffer during this stage of intense mutation, and facile neuromuscular action is inhibited. They are less able to perform faster melismatic passages and wider pitch intervals at faster speeds. The stiffened folds are less flexible, and a moderate pitch range for sung music would be helpful for longer-term voice skill development. An emphasis on release of unnecessary neck-throat muscles and efficient laryngeal coordination is needed. Cultivation of easy phonation will be valuable. Falsetto register will be affected most by vocal fold stiffness, as the vocal folds must be at their thinnest and most taut. Stiffened vocal folds that are stretched taut are more resistant to being induced into ripple-waving by breathflow. Under those circumstances, forcing falsetto register pitches into use will create unnecessary laryngeal effort. (p. 605)
>
> Newvoices [formerly called New Baritones in Cooksey's earlier classifications] lack agility and flexibility, compared to adult expectations. . . . In singing, cultivation of efficient laryngeal function in relation to efficient breath energy will enable increased agility and lower muscle fatigue rates. (p. 606)
>
> Emerging Adult [formerly called Settling Baritone in earlier classifications]. Voices can sing with greater agility when compared to Newvoices, but physical development and motor programming for voices

> must continue before adult agility can be realized. . . . Continued cultivation of efficient laryngeal function in relation to efficient breath energy will enable increased agility and lower muscle fatigue rates. (p. 607)

Summary

It is easy to understand why there is a plethora of information published about the male adolescent voice change. Music teachers, who daily face a classroom of students with normally developing changing voices, need reliable information. There are many researchers who have been interested in the phenomenon of the changing voice. Each accumulation of knowledge has brought us to where we are today, closer to answering questions about (a) the workings of the larynx, (b) the physiological maturation of pubescent/adolescent boys, (c) the charting and measuring of vocal ranges possible for use in selecting appropriate repertoire, (d) whether or not we can predict adult vocal characteristics based on characteristics during mutation, (e) whether one pedagogical approach is better than another approach, (f) phenomena of AVC and how they may be interrelated, and finally, (g) how agility as one characteristic of the adolescent changing voice may be measured and considered in composing or choosing appropriate repertoire.

Previous researchers have discovered that agility may be diminished in the adolescent male changing voice. However, a consistent method for measuring how lyrics may or may not have had an effect on agility, or whether increasing tempo incrementally may have had an effect on agility were not used. Therefore, this study attempts to provide a method for more precise measurement lacking in previous studies.

Chapter Three describes a method whereby vocal agility has been measured. The writings of many of the preceding authors have been considered and put into effect in this attempt at measuring vocal agility in the changing voice. The measurements of Ekstrom

(1959), as general observations of "Very," "Moderately", and "Not" agile, and the "Good," "Fair," or "Poor" scaled used by Groom (1979) are to be extended in this present study to a numeric measurement on a scale from zero to five. Based upon Cooksey's (1977, 1997) range determinations, the subjects are placed into stages of voice change, and then step-wise agility levels are measured by independent judges. The AVC boys' vocal agility levels are then compared with the Cooksey vocal range stages, and also compared by presence or absence of lyrics, tempo, and years of experience in choir.

CHAPTER THREE

Method

This study was designed to explore elements of the pubescent/adolescent voice change. The literature concerning the male vocal mutational phenomenon has been copious and varied. Authors have agreed and disagreed on philosophies of when, how, and why boys should or should not sing during this normal vocal maturation. Experts in the field of AVC (adolescent voice change) have argued what kind of singing is most beneficial for children's future as adult singers. Researchers have observed characteristics that are peculiar to the male singer during his maturational stages. This descriptive design was intended to add to the body of knowledge about what the normal singing agility levels for American students might be.

The purpose of this study was to measure the agility of boys' voices during various pubescent and adolescent mutational stages. Possible implications for the music educator include appropriate expectations of the capabilities of middle level singers and appropriate selection of repertoire containing melismatic material for this age group.

Questions pertaining to agility in the male pubescent or adolescent were:

5. Does vocal agility change as boys progress through voice change stages as identified by Cooksey and Cooper?
6. Is there a difference in vocal agility between a vocalise sung with lyrics and a vocalise sung with the voiced vowel "ahhh?"
7. Are there tempi at which the voice is more or less agile?
8. Is there a relationship between years of choir experience and vocal agility?

Participants

Fifty-eight participants ($N = 58$) were available male volunteers in grades five through nine, in the Midwestern United States. Students from two elementary schools (grades K-5), three middle schools (grades 6-8), one middle school (grades 6-8), and two junior high schools (grades 8-9) participated in the study. Ages ranged from 11.5 years to 15.9 years. All but one of the schools were in the same school district in a city with a population of 84,531 (2000 census). This city is home to a major state university. One middle school is in a town within 30 miles of the first city, within the same county. This town's population was 3,774 (2000 census). The data were recorded by a single researcher during short visits to each of these schools, all within one spring semester.

Initially, 75 boys signed up to participate in the study. Grades five through nine were selected, because typically the AVC begins around age 11 and is completed around age 16. Since only boys who had begun the first stage of voice change were to be included, 17 students who had unchanged voices participated, but were not included in the final results.

Prior to recording the data, the researcher obtained permission to conduct research with human subjects with the Institutional Review Board of the University of Missouri-Columbia. Parents or guardians signed letters of informed consent to allow the children to participate (Appendix B). Boys signed assent forms to indicate their willingness to complete the study (Appendix B).

On a student questionnaire (Appendix C), each participant recorded his singing experience, defined as the years he had sung in a choir. Choir experience could have been school, church, or community choirs. He recorded choral experience in increments

of 1/3 year or semesters (0.3, 0.6) if total experience was less than 1 year, and in yearly increments if experience was more than one year. I asked whether or not he had taken private voice lessons, and he responded by checking yes or no. Because there were so few boys who had taken voice lessons, I decided that this variable could not be tested, but is discussed in the final chapter of this document. Other demographic information included age (in months) which ranged from 11.5 to 15.9 years. Age was noted, but not analyzed as an independent variable because the research in this area has already been extensive. I asked the question concerning the first language spoken at home because I thought that the differing vowels or consonant formations might affect the lyrics variable. Because none of the subjects appeared to have a spoken language dialect that was much different from the other Midwestern subjects, I did not test for this variable. However, the possible impact of language is discussed in Chapter Five. While I did not inquire about the physical health of the students, a few spoke of perceived respiratory conditions as they gave me their questionnaires.

Independent Variables

Possible participant characteristics that may have affected results, such as talent or innate ability, emotional condition, physical condition, speech or language development, and room acoustics were not measured or controlled in this study. In addition, information about the students' experiences with agility exercises in a choir or private voice lessons was not explored.

Independent Variable: AVC Ranges in Cooksey Stages or Cooper Categories

Comparisons of age and stage of voice change have been made by researchers in the fields of pediatrics and laryngology (Kahane, 1975; Schonfeld, 1943), phonology

(Curry, 1940; Pedrey, 1945), and many more in the field of music education (Baressi, 1984; Buckton, 1976; Coffman, 1968; Cooksey 1977, 2000; Cooper, 1956; Dorman, 1994; Emge, 1996; Ekstrom, 1959; Friesen, 1972; Hughes, 1984; Joseph 1965; Killian, 1999; Richison, 1971; Rutkowski, 1985; Swanson, 1959). Although there existed physical variability among individuals, participants' differing climatologic locations, and differing hereditary factors, researchers have more or less agreed that the vocal ranges of boys during AVC follow a general pattern of a lowering in spoken and singing pitch as boys age.

Independent Variable: Lyrics

Lyrics are integrally tied to singing and to choral music. Swan (1973), in describing the development of a choral instrument, wrote about six schools of choral music in America. Swan's sixth "school" referred to the philosophy and procedures used primarily by Robert Shaw. The term *speech*, used as a synonym for text or diction, was one of five choral techniques. Swan named four other choral techniques: pitch, tone, dynamics, and rhythm (cited in Decker & Herford, 1973, p. 34). Choral musicians have practiced speech (enunciation of the text) within singing as an integral part of choral song. However, words are not always used when singing. There are some instances in which vocal music does not use lyrics. These may be (a) during vocal technique building such as exercises and warm-ups, (b) in melismatic passages where a vowel has been extended over a number of different pitches (e.g., the syllable "fy" in the chorus "And He shall purify" from Handel's *Messiah*), (c) within a song that has lyrics, but may have a non-language passage (such as "E-I-E-I-O" in "Old McDonald Had a Farm"), or (d) in standard solo vocal repertoire songs such as Chenoweth's Vocalise, which employs only

vowels in melodic lines (Chenoweth, 1961). Although it is apparent that the absence of language or text has been used in vocal music, I found no studies measuring the effect that lyrics or no lyrics may have on agility.

Independent Variable: Tempo

The speed at which the voice must change from one pitch to another within a given meter or tempo presents a challenge for singers. As changes in speed occur, the singer is required to maneuver his vocal instrument to accommodate those changes. As Swan stated, "Time is music's canvas…Not only must a singer make every sound in a musical phrase; he must make them in tempo and with rhythm." (Decker & Herford, 1973, p. 35, 37) Although tempo is an integral element of music, I found no studies measuring the effect that tempo may have on vocal agility.

Independent Variable: Choral Experience

There have been collective assumptions about the correlations between the amount of singing practice and ability to sing agilely. Voice teachers have written extensively about exercises meant to improve the agility of the adult singer (Miller, 1986; Coffin, 1987; Brown, 1996; Vennard, 1967; Caldwell (ed.), 2001). . However, little is mentioned about the effectiveness of agility exercises specifically for boys experiencing the voice change (Barham, 1991).

Dependent Variable: Vocal Agility

The dependent variable in this study was agility scores collected from a vocalise created to approximate step-wise melismatic passages often found in Baroque music. The vocalise was an extention of the motif from Harold Arlen's "Follow the Yellow Brick Road," from the musical, *The Wizard of Oz.* This melody was chosen for its

narrow range of a perfect fourth, its stepwise motion, and its familiarity to American boys. The extended vocalise created a diatonic stepwise pattern with two intervals of a major second and one interval of a minor second. Hence, the extended vocalise was *Follow the yellow-brick, follow the yellow-brick, follow the yellow-brick road*, on the pitches: do-re-mi-fa-mi-re-do-re-mi-fa-mi-re-do, etc., in a florid eighth-note rhythmic pattern (see Appendix D).

In order to answer the research question concerning a comparison between singers using lyrics, and singing on a vowel, I decided that agility should be measured using the Arlen lyrics, then singing the vocalise on the "ahhh" vowel. Agility scores achieved with lyrics, "Follow the yellow brick, follow the yellow brick, follow the yellow brick road" were labelled "WithL." Agility scores achieved from the vocalise sung without lyrics were labelled "WithoutL."

The tempi selected were in increments of 20 beats per minute from 80 through 180. These tempi were selected because 80 (dotted quarter note equals 80 beats per minutes in 6/8 meter) was believed to be relatively slow and easy for a majority of boys to achieve, and 180 quite fast and difficult. I decided to include six tempi so that each could be tested to discover if agility was easier at a particular tempo. It also seemed that this was sufficient to examine possible differences, and not too many so as to result in fatigue or boredom by the boys (see Appendix D).

Procedures

Cooksey Range Stage Determination

As a preliminary step, the adolescent males were asked to speak in order for the researcher to determine the average lowest speaking pitch. The researcher was a choral

music teacher with 17+ years experience teaching adolescent male and female singers. This experience has included checking ranges and identifying voice stages for hundreds of boys. This procedure (Baressi & Bless, 1984; Cooksey, 1992; Killian, 1999; Moore, 1995) has been an accepted practice in determining where to comfortably begin the process of exploring the boys' singing range; with the lowest speaking pitch usually occuring 3-4 half-steps above the lowest note of the singing range (Cooksey 1977, 2000; Rutkowski, 1984).

After stating his anonymous research number on the recording, each boy then sang a descending vocalise from about the middle of his suspected range to the LTP (Lowest Terminal Pitch), then beginning about the middle of the range again, sang an ascending pattern to his HTP (Highest Terminal Pitch). Boys who were suspected by their speaking voices to be in Cooksey's Stage I: (Midvoice I) through Stage IV: (New Baritone or Newvoice) ranges were asked to sing descending (followed by ascending) vocalises of three pitches each (mi-re-do) because of the more limited extent of their singing ranges. Boys who were suspected by their speaking voices to be in Cooksey's Unchanged Stage, or Stage V: (Settling Baritone or Emerging Adult Voice) were generally asked to sing the descending (then ascending) vocalise of five pitches each (sol-fa-mi-re-do) because of the slightly larger extent of their expected singing ranges. All students were assisted in this range process by the piano playing pitches as they sang. Participants were then placed in one of the Cooksey Range Stage categories according to their LTP and voice quality characteristics previously observed (Barresi, 1984; Cooksey, 1977; Groom, 1979). The range-establishing process was recorded on a Sony mini-disc recorder.

Cooper Category Determination

The determination of the categories "cambiata" or "baritone" was made from the recorded ranges. Vocal ranges in the cambiata category match the first three Cooksey stages, and the baritone range category matches the last two Cooksey stages. Therefore, the researcher assigned boys from the first three Cooksey stages to Cooper's cambiata category, and the last two Cooksey stages to Cooper's baritone category for further analysis. This twin analysis of Cooksey stages and Cooper categories was made because music educators may follow one or the other of these range applications.

Preparing the Vocalise Recordings

On five separate CD's, the vocalise starting pitches were recorded in keys corresponding to that participant's stage or category. Instructions, examples and practice time were recorded on tracks one through three. Along with verbal instructions for the participant, the starting pitches and a chord were played to assist the participant in determining tonality. These chords, using "do" as the median starting pitch, were recorded on each of the five compact discs, one disc for each Cooksey stage. This meant that the participant would be asked to sing in the less comfortable part of his range. The reason for this choice of pitch was to keep the participant singing in his tessitura, but still to challenge his vocal agility.

Each starting pitch and chord was recorded with a "grand piano" from a Roland KR-7 keyboard onto a 3 ½ inch floppy disc, then transferred to compact discs in separate tracks on a Superscope model PSD 300 CD recording system. Tracks on the CD were separated as track one, instructions for the participant from the researcher; tracks two &

three, examples and practice time for the participant; and tracks four through nine, starting pitch followed by a chord played on a Roland KR7 piano using the default grand piano sound. Track four also contained the metronomical clicking at tempo 80 (dotted quarter note = 80 beats per minute) for a duration of one minute, and each successive track (five through nine) increased the tempo by 20 beats per minute until tempo 180 (dotted quarter note = 180 beats per minute) was reached.

As preparations were made for the recording of pitch, chord, and metronome beats, I anticipated that other researchers might assist me in the data gathering process. Because I wanted to ensure reliability, I made a script of instructions that I recorded onto compact disc. Although I was able to complete the data gathering without help from other researchers, the following recorded script which had been written in third person, was played for the participant or paraphrased by the researcher when a time restraint was necessary:

> Track One: Welcome, singer. You are here to participate in a study about the singing voices of boys in your age group. Relax and listen to the instructions, then sing directly into the microphone as instructed. You will have plenty of time to complete each task, so you may stop and ask questions at any time.
>
> You will hear the piano play a chord and your starting pitch. Hum the starting pitch so that you can hear and feel yourself singing it, then begin with the beat whenever you are ready.
>
> You may stop and tell the researcher (that's the adult in the room with you) that you do not want to continue, at any time. Thank you for agreeing to

make this recording. It will help us tell what average speeds boys are able to sing in your age group.

This exercise is in two parts. In part one, the researcher will ask you to sing some scales so that your range (that's the highest and lowest note you can sing), will be determined. We will record part one.

In part two, you will sing a short melody with words, and "ahhh." The beginning note and a chord will be played at the beginning of each track on the CD. Then you will hear a steady beat. You may start singing with the steady beat whenever you feel comfortable. There are three notes per beat.

On the second track of the CD, you will hear an example. You may practice with the example until you are ready to go on. Each track gets just a little faster. If you are unable to keep up with the speed, that's o.k., just try your best. You are assigned a number which you will speak into the microphone when the time is right. The number assures that no one who listens to the recording will know who you are. The researcher will tell you your number now.

Track Two: O.K., let's record your number, then follow the researcher's directions for determining your range. Very good. Now, let's practice the "Follow the yellow brick road" exercise. Here is an example. [I sang and recorded the exercise myself, then gave the boy an opportunity to practice it with me if he wished] at tempo 80, with the metronomical clicking in the background].

Track Three: Excellent practice. Now you're ready to sing the exercise with the steady beat. Remember, you will hear the piano play a chord and your

starting pitch. Hum the starting pitch so that you can hear and feel yourself singing it, then begin with the beat whenever you are ready.

Recording

The rooms in which the recordings were made were different in each school. One school had a practice room available within the choir room. In two of the schools, the recording was made in the teacher's office. Two schools' recordings were made in the music room when the rest of the class was outside of the room. The final school's recordings were made in a vacant hallway outside the music room. The same microphone was used for all recording.

When the participant was ready to record his voice, he gave me his completed questionnaire, and entered the room where the recording would take place. During this time, I talked with him and listened to his speaking voice to get an indication of what pitch I might use to begin the three to five note scales he would sing in to determine his vocal range. He listened to the instructions, and completed the range determination portion of the exercise. After the range was determined, it was compared with the LTP, total range, and tessitura on a Cooksey range chart. Observations were also made about the student's tone quality. I determined which Cooksey stage this participant would best fit, and marked it on the student's questionnaire.

The participant then practiced the vocalise as the researcher sang along. I also explained the procedure of singing the vocalise with the lyrics first, followed by the "ahhh" vowel. If the participant started his recording in the unintended order (i.e., singing "ahhh" first), I gently corrected him. He began again using lyrics before singing with the "ahhh" vowel.

When the participant indicated that he had practiced enough, understood the procedure, and felt ready to begin, one of five pre-recorded compact discs, corresponding to the starting pitches for the boy's stage, was placed in the portable Phillips AZ1040 CD Radio Cassette Recorder/Player.

The participant was asked to begin the recording by stating his 3-digit participant number to preserve his anonymity. He was then asked to sing the vocalise after the median pitch in his prescribed stage range was given, then once with the starting pitch beginning one-half step higher than the median pitch. Although the participant sang the vocalise twice with differing starting pitches, it became clear in listening to the recordings that most boys did not actually sing a half step higher. These responses did not add enough information to the study to the data to warrant time spent to assess and analyze them, however, so they were not considered further.

I did not sing along with the participant during the participant recording session. However, I assisted the participant in staying with each tempo using conducting-type gestures and body movements. I continued to give the participant verbal praise as he continued the task. As he finished each track, the CD was advanced to the next track for the participant to hear the starting pitch, chord, and clicking to begin singing at the next tempo. Tempi 80, 100, 120, 140, 160, and 180 were always recorded in the order of slowest to fastest. The participant's resulting vocalises in each key and tempo were recorded on a Sony mini-disc recorder. Upon conclusion, the participant was verbally thanked for his part "in discovering more about male changing voice singers."

Preparing Data for Analysis

The participant recordings were placed in a randomized order and copied in that order with a Dell PC Dimension 4550 Intel Pentium four processor computer onto a MP3 file using Jukebox by Musicmatch software. These randomized files were then copied onto four blank Maxell CD-R media using the same Dell Computer for subsequent evaluation.

Adjudication of the Vocalise

The recorded vocalises were judged by two vocal music teachers to determine agility and certainty of pitches for each participant. Judges were selected on the basis of their years of experience teaching adolescent singers. Judge A had taught 27, years and Judge B had taught 13 years, in Midwestern public schools.

The judges rated the recordings all in one day. Prior to the adjudication session, the judges completed a training session in which they were instructed to consider only the agility of the voices they were to hear. They were also instructed that the voices would be pubescent or early adolescent voices, and they should expect to hear students of that age level. Judges were instructed to compare the top rating of a participant to a rating they might give the best male AVC singer in a choir that they were conducting. They were instructed that the lowest score should be given to an AVC singer who could not move his voice at all or very little from pitch to pitch.

The judges then listened to a prerecorded training example of an adult woman and an adult man who had previously heard and then mimicked the participant recordings. There were prerecorded examples designed to approximate a variety of agility levels, sung at tempo ♩_{0}=80. The judges were told that they might hear similar examples by the

real participants. A rubric was provided and discussed to clarify for the judges how each numerical rating might be decided (see Table 1).

Table 1. Agility Adjudication Rubric

0	1	2	3	4	5
Does not move the voice at all from one pitch to the next expected pitch	Moves the voice very little from one pitch to the next expected pitch	Sometimes moves the voice from one pitch to the next expected pitch	Often moves the voice from one pitch to the next expected pitch with some precision	Frequently moves the voice from one pitch to the next expected pitch with good precision	Consistently moves the voice from one pitch to the next expected pitch with outstanding precision

Following the discussion of how to use the rubric, the judges listened to eight random examples from the anonymous participants. They then practiced rating the agility levels and discussed what rating was appropriate until they felt that they were in agreement. This training process was recorded on a Sony mini-disc recorder by the researcher.

When the judges declared they were ready to begin the actual adjudication of the participants, they were each given a stack of adjudication forms (Appendix E) with each participant's anonymous number written in the upper left corner. They began by checking the participant's stated number on the recording with the number written at the top of the adjudication form. They marked ratings on the adjudication form, (assisted by the rubric), by circling numbers on a scale of 0 to 5, judging their perceptions of how agilely each participant sang. They were instructed by the researcher not to talk about their ratings with each other once the actual adjudication process began.

The two judges' scores were tested for interjudge reliability using the Microsoft Excel software program to calculate correlations for each set of ratings by tempo and WithL (with lyrics). Interjudge reliability ranged from 0.74 to 0.90 (Table 2).

Table 2: Interjudge Reliability Correlations for Each Tempo with Lyrics Category

With Lyrics Tempi	Interjudge Reliability Correlation
dotted quarter note = 80	0.90
dotted quarter note =100	0.85
dotted quarter note =120	0.85
dotted quarter note =140	0.74
dotted quarter note =160	0.84
dotted quarter note =180	0.81

The judges' scores for WithoutL (without lyrics) were tested in the same manner (see Table 3). These interjudge reliability correlations ranged from 0.75 to 0.89.

Table 3: Interjudge Reliability Correlations for Each Tempo without Lyrics Category

Without Lyrics Tempi	Interjudge Reliability Correlation
dotted quarter note = 80	0.88
dotted quarter note =100	0.89
dotted quarter note =120	0.80
dotted quarter note =140	0.81
dotted quarter note =160	0.75
dotted quarter note =180	0.83

According to Leonard and House (1972), correlation figures offer a validity test that may be interpreted as follows, (p. 398)

.85 - .99	high to very high; valuable for individual measurement and diagnosis
.80 - .84	fairly high; some value in individual measurement and highly satisfactory in group measurement
.70 - .79	rather low; adequate for group measurement; of doubtful value in individual measurement
.50 - .69	low; inadequate for individual measurement, but of some value in group measurement
below .50	very low; inadequate for use

Thus, correlations obtained were considered to be high enough for the resulting statistical tests of group measurement. Additionally, out of 696 total scores, 446 (64%) were judged with exactly the same rating from the two independent judges, 242 (35%) were one rating apart, and only 8 (1%) were two ratings apart.

The data collected were analyzed using a 3-way ANOVA and Pearson Product-Moment Correlation. Data analyses were computed using the Microsoft Windows Excel software program and the SPSS 13.0 for Windows Graduate Student Version statistical analysis software program. These results will be reported in the following chapter.

CHAPTER FOUR

Results

The results of this study regarding the agility levels of singers during the male adolescent voice change are discussed in this chapter. The purpose of this study was to assess the agility of boys' voices across differing stages of development for vocalizes sung with or without lyrics at different tempi. Possible implications for the music educator include information which may be used when developing appropriate expectations of the capabilities of middle level singers and selecting appropriate repertoire for this age group. The research questions are restated here:

1. Does vocal agility change as boys progress through voice change stages as identified by Cooksey and Cooper?
2. Is there a difference in vocal agility between a vocalise sung with lyrics and a vocalise sung with the voiced vowel "ahhhh?"
3. Are there tempi at which the voice is more or less agile?
4. Is there a relationship between years of choir experience and vocal agility?

Null Hypotheses

The null hypotheses for this study have been organized to reflect the analyses for both the Cooksey stages philosophy and for the Cooper cambiata method philosophy. The participants were identified by their singing ranges into one of five Cooksey range stages, beginning and midvoice ranges and baritone stages. These same participants were then re-sorted by singing range into either the Cooper cambiata range category (first three Cooksey stages) or the Cooper baritone range category (last two Cooksey stages). Each of the following null hypotheses were applied to Cooksey range stages.

H_{01}: There are no significant differences in mean agility scores among Cooksey range stages.

H_{02}: There are no significant differences in mean agility scores with and without lyrics.

H_{03}: There are no significant differences in mean agility scores across tempi.

H_{04}: There are no significant lyrics by stages interactions among mean agility scores.

H_{05}: There are no significant tempo by stage interactions among mean agility scores.

$H_{06:}$ There are no significant lyric by tempo interactions among mean agility scores.

$H_{07:}$ There are no significant lyrics by tempo by stage interactions among mean agility scores.

Each of the following null hypotheses were applied to Cooper categories.

H_{08}: There are no significant differences in mean agility scores between Cooper categories.

H_{09}: There are no significant differences in mean agility scores with and without lyrics.

H_{10}: There are no significant differences in mean agility scores across tempi.

H_{11}: There are no significant lyrics by stages interactions among mean agility scores.

H_{12}: There are no significant tempo by stage interactions among mean agility scores.

H_{13}: There are no significant lyric by tempo interactions among mean agility scores.

H_{14}: There are no significant lyrics by tempo by stage interactions among mean agility scores.

An eighth hypothesis tested the final research question: does the amount of choral experience correlate with agility in AVC boys?

H_{15}: There is no significant correlation between amount of choral experience and mean agility scores.

An alpha level of .05 was selected as the standard of rejection for all of the null hypotheses. Data analyses were computed using the Microsoft Windows Excel software program and the SPSS 13.0 for Windows Graduate Student Version statistical analysis software program.

Analysis for Cooksey Range Stages

Descriptive statistics including means and standard deviations for scores of boys placed into the five stages of voice change as defined by Cooksey are presented in Table 4. These are sorted by lyric and tempi conditions to correspond to the analyses of null hypotheses 1-7.

Table 4

Means and Standard Deviations by Cooksey Stages, Lyrics, and Tempi

With Lyrics Tempo	T80	T100	T120	T140	T160	T180	Totals
Stage 1							
M	3.00	3.06	2.88	2.50	2.19	1.88	2.61
SD	1.20	1.02	0.86	0.85	0.65	0.35	0.69
Stage 2							
M	3.42	2.96	2.96	3.00	2.55	2.00	2.80
SD	1.10	1.14	0.94	0.80	1.01	0.80	0.91
Stage 3							
M	3.43	3.36	3.07	2.93	2.79	2.36	2.99
SD	1.02	1.25	1.02	0.89	0.86	0.99	0.97
Stage 4							
M	3.44	3.41	3.59	3.38	3.19	2.78	3.30
SD	1.15	1.02	0.97	1.07	1.01	1.02	0.97
Stage 5							
M	3.77	3.80	3.77	3.63	3.30	3.03	3.55
SD	1.28	1.15	1.07	0.97	1.15	1.03	1.05
Totals							
M	3.46	3.36	3.37	3.19	2.88	2.51	3.13
SD	1.15	1.11	1.01	0.99	1.05	0.99	0.97

(Table continues on next page)

(Table 4, continued)

Without Lyrics Tempo	T80	T100	T120	T140	T160	T180	Totals
Stage 1							
M	2.38	2.50	2.00	1.94	1.50	1.38	1.95
SD	1.09	1.20	1.04	0.90	0.85	0.74	0.87
Stage 2							
M	2.83	2.54	2.29	2.21	1.88	1.46	2.20
SD	1.05	1.18	0.78	0.58	0.88	0.84	0.81
Stage 3							
M	2.86	2.79	2.50	2.50	2.29	1.86	2.46
SD	1.07	0.99	0.96	1.00	0.70	0.94	0.89
Stage 4							
M	3.09	2.50	2.66	2.53	2.19	1.94	2.51
SD	1.15	1.17	1.04	1.09	0.95	0.87	1.00
Stage 5							
M	3.60	3.27	2.93	2.73	2.57	2.23	2.89
SD	1.27	1.18	1.00	0.86	0.98	0.75	0.96
Totals							
M	3.04	2.77	2.54	2.43	2.14	1.83	2.47
SD	1.18	1.16	0.99	0.92	0.94	0.86	0.95
Totals for Tempi							
M	3.25	3.06	3.01	2.81	2.51	2.17	
SD	1.14	1.11	1.07	0.93	0.97	0.89	

Based on observation of these data, progressively improving scores are apparent, indicating gradual increases in agility for both the WithL and WithoutL groups, from Cooksey stage one through stage five. Within stages, however, the scores generally decreased as tempi increased, with a few exceptions.

In the WithL group, standard deviations ranged from 0.35 in stage one T180, to 1.28 in stage five T80. In the WithoutL group, standard deviations ranged from 0.74 in stage one

T180 to 1.27 in stage five T80. The variability among participants generally declined as participants sang faster.

In the WithL group, mean scores ranged from a low of 1.88 in stage one T180, to highs of 3.77, 3.80, and 3.77 in stage five T80, T100, and T120, respectively. In other words, the lowest group score belonged to participants in the earliest stage of AVC, at the fastest tempo. The highest group score belonged to participants in the latest stage of AVC, at slower tempi.

In the WithoutL group, mean scores ranged from a low of 1.38 in stage one T180, to a high of 3.60 in stage five T80. As for the WithoutL scores, the lowest group score belonged to participants in the earliest stage of AVC, at the fastest tempo, and the highest group score belonged to participants in the latest stage of AVC, at the slowest tempo.

A three-way ANOVA with repeated-measures on two factors was used to compare the stage, lyric, and tempo conditions. Results indicated that there were no significant differences attributable to the main effect of stage F (4, 53) = 1.80, $p > .05$, but that there were significant differences among lyrics conditions F (1, 53) = 265.69, $p < .05$ and among tempi F (5, 265) = 60.43, $p < .05$. While neither of the two-way interactions that included the Cooksey stage variable were significant $F_{lyrics\ by\ stage}$ (4, 53) = 1.43, $p > .05$; $F_{tempo\ by\ stage}$ (20, 265) = 0.95, $p > .05$, there were significant differences in the other two-way interaction in this analysis $F_{lyrics\ by\ tempo}$ (5, 265) = 4.50, $p < .05$, and for the three-way lyrics by tempo by stage interaction $F_{lyrics\ by\ tempo\ by\ stage}$ (20, 265 = 1.83) $p < .05$. Thus, for the Cooksey stages, null hypotheses $H_{02,}$ $H_{03,}$ $H_{06,}$ and H_{07} were rejected, but null hypotheses $H_{01,}$ H_{04} and H_{05} were not rejected (see Table 5).

Table 5

Summary Table: Repeated Measure ANOVA Comparing Cooksey Stages by Lyrics and Tempi

Source of Variance	SS	df	MS	F	p
Between Subjects					
Stage	72.75	4	18.19	1.80	.14
Error	536.67	53	10.13		
Lyrics x Stage	1.42	4	.35	1.43	.24
Tempo x Stage	5.33	20	.27	.95	.52
Lyrics x Tempo x Stage	3.16	20	.16	1.83	.02*
Error	22.89	265	.09		
Within Subjects					
Lyrics	65.80	1	65.79	265.69	.00*
Error	13.12	53	.25		
Tempo	84.48	5	16.90	60.43	.00*
Error	74.10	265	.28		
Lyrics x Tempo	1.94	5	.39	4.50	.00*
Error	22.89	265		.09	

*$p < .05$

Means (with standard deviations in parentheses) contributing to the main effect for lyrics and without lyrics are 3.13 (0.97) and 2.47 (0.95) respectively. Average ratings were significantly higher for vocalises sung with words.

To determine where the significant differences occurred among the six tempi, a Bonferroni post hoc analysis was computed. Results indicated that the means for the slowest three tempi, T80, T100, and 120, were not significantly different from one another. The mean for T140 was significantly lower than for T80 and T100, but did not differ significantly from T120. Both the mean for the two fastest tempi, T160 and T180, were significantly different from each other and from all other means (see Table 6).

Table 6

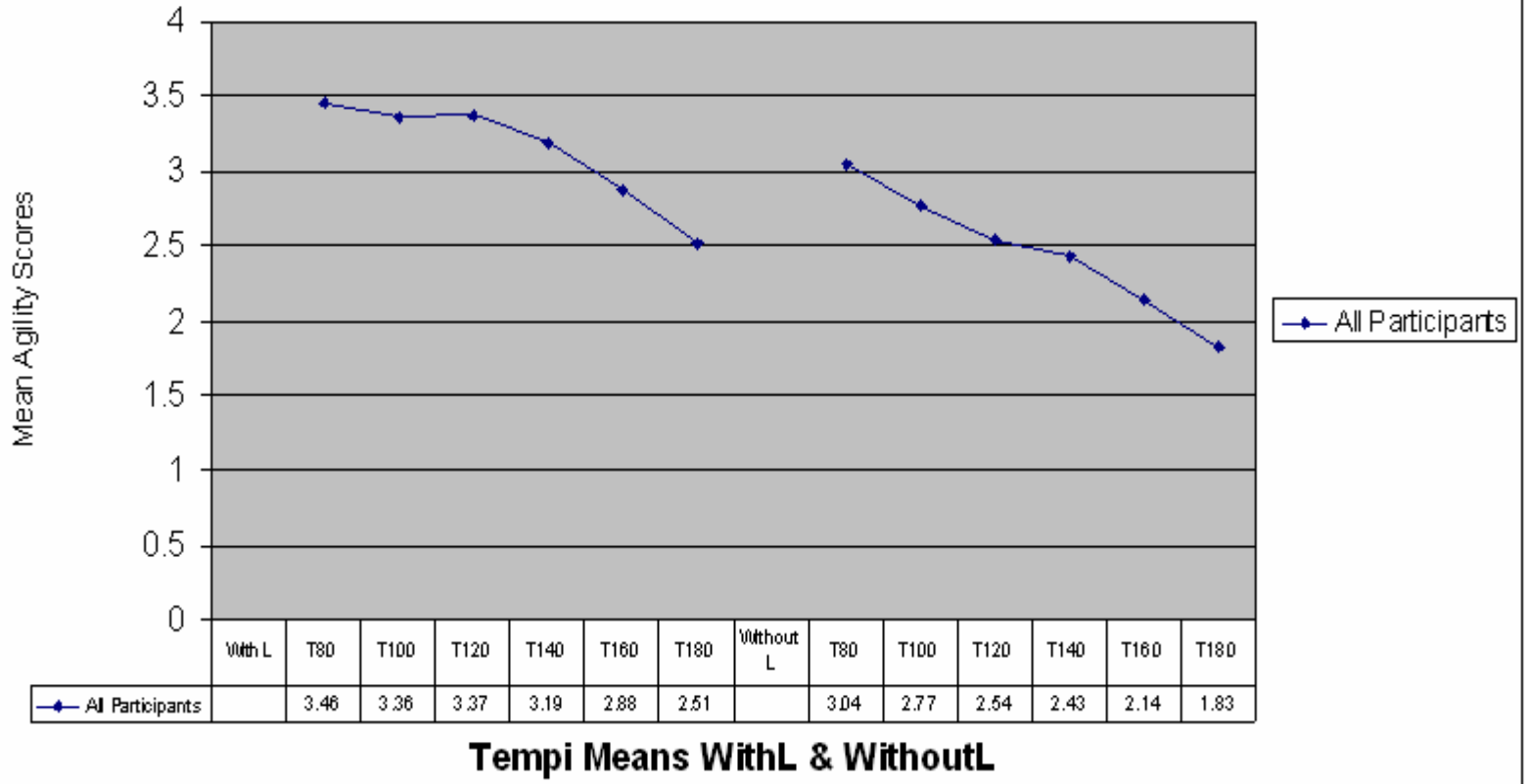
Means and Standard Deviations for Vocalises Sung at Each Tempo (Cooksey)

	T80	T100	T120	T140	T160	T180
M	3.25	3.06	3.01	2.81	2.51	2.17
SD	1.14	1.11	1.07	.93	.97	0.89

Note: Means connected with underlines are not significantly different, ($p < .05$).

The means contributing to the significant lyrics by tempo interaction are presented in Table 7and graphed in Figure 1. While the means generally decline across as tempo increases for both WithL and WithoutL conditions, the patterns are slightly different at the lower tempi. With lyrics, there is a smaller decline from T80 to T100 than without, and means for T100 and 120 are virtually equivalent. Without lyrics, the means decline more steadily for these lower tempi. Means for both conditions decline at similar rates from T120 through T180.

Figure 1: Graph of the Means of the Lyrics by Tempo Interaction (all participants)



	With L	T80	T100	T120	T140	T160	T180	Without L	T80	T100	T120	T140	T160	T180
All Participants		3.46	3.36	3.37	3.19	2.88	2.51		3.04	2.77	2.54	2.43	2.14	1.83

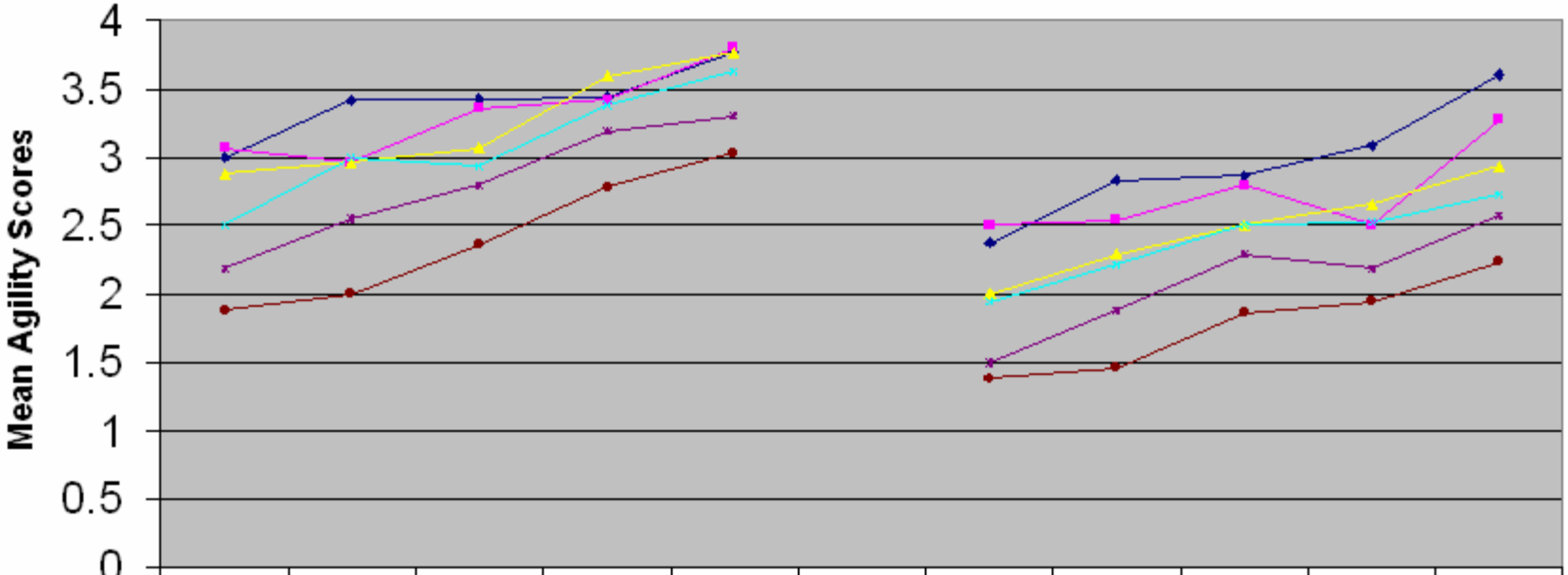
Table 7

Means and Standard Deviations Contributing to the Lyrics by Tempo Interaction (Cooksey)

With Lyrics Tempo	T80	T100	T120	T140	T160	T180
M	3.46	3.36	3.37	3.19	2.88	2.51
SD	1.15	1.11	1.01	0.99	1.05	0.99
Without Lyrics						
M	3.04	2.77	2.54	2.43	2.14	1.83
SD	1.18	1.16	0.99	0.92	0.94	0.86

The data contributing to the three-way lyrics by tempo by stage interaction were presented above in Table 4. Because of the complexity of these data, means were graphed to present a visual representation for further analysis (see Figure 2). While the graph displays a few differences among the patterns of responses for the various stages, there is nothing here that is particularly dramatic or readily explainable. While scores were generally equivalent or higher for each successive stage and faster tempo, this pattern did not hold true for stage 4 both WithL and WithoutL, Some small discrepancies may also be noted for stage 2 WithL and stage 1 WithoutL at the slower tempi.

Figure 2: Graph of the Means of the Lyrics by Tempo by Cooksey Stage Interaction



	st.1 WithL	st.2 WithL	st.3 WithL	st.4 WithL	st.5 WithL		st.1 WithoutL	st.2 WithoutL	st. 3 WithoutL	st.4 WithoutL	st.5 WithoutL
T80	3	3.42	3.43	3.44	3.77		2.38	2.83	2.86	3.09	3.6
T100	3.06	2.96	3.36	3.41	3.8		2.5	2.54	2.79	2.5	3.27
T120	2.88	2.96	3.07	3.59	3.77		2	2.29	2.5	2.66	2.93
T140	2.5	3	2.93	3.38	3.63		1.94	2.21	2.5	2.53	2.73
T160	2.19	2.55	2.79	3.19	3.3		1.5	1.88	2.29	2.19	2.57
T180	1.88	2	2.36	2.78	3.03		1.38	1.46	1.86	1.94	2.23

Analysis for Cooper Range Categories

Descriptive statistics including means and standard deviations for scores of boys placed into the two categories of voice change as defined by Cooper are presented in Table eight. These are sorted by lyric and tempi conditions to correspond to the analyses of null hypotheses 8-14.

Table 8

Means and Standard Deviations by Cooper Categories, Lyrics, and Tempi

With Lyrics Tempo	T80	T100	T120	T140	T160	T180	Totals
Cambiates							
M	3.30	3.09	3.02	2.83	2.39	2.06	2.80
SD	1.09	1.10	1.00	0.83	0.99	0.75	0.84
Baritones							
M	3.60	3.60	3.62	3.50	3.24	2.90	3.42
SD	1.21	1.08	0.97	1.02	1.06	1.01	1.00
Totals							
M	3.46	3.36	3.37	3.19	2.88	2.51	3.13
SD	1.15	1.11	1.01	0.99	1.05	0.99	0.97

Without Lyrics Tempo	T80	T100	T120	T140	T160	T180	Totals
Cambiates							
M	2.70	2.57	2.37	2.15	1.87	1.54	2.19
SD	1.05	1.09	1.03	0.86	0.85	0.83	0.84
Baritones							
M	3.31	2.92	2.83	2.63	2.37	2.08	2.70
SD	1.24	1.20	1.07	0.97	0.97	0.82	0.99
Totals							
M	3.04	2.77	2.54	2.43	2.14	1.83	2.47
SD	1.18	1.16	0.99	0.92	0.94	0.86	0.95
Totals for Tempi							
M	3.25	3.06	3.01	2.81	2.51	2.17	
SD	1.14	1.11	1.07	0.93	0.97	0.89	

In observing these data, scores increase in agility from the cambiata to baritone categories for both the WithL and WithoutL groups. Within the categories, however, the scores generally decreased as tempi increased, with a few exceptions.

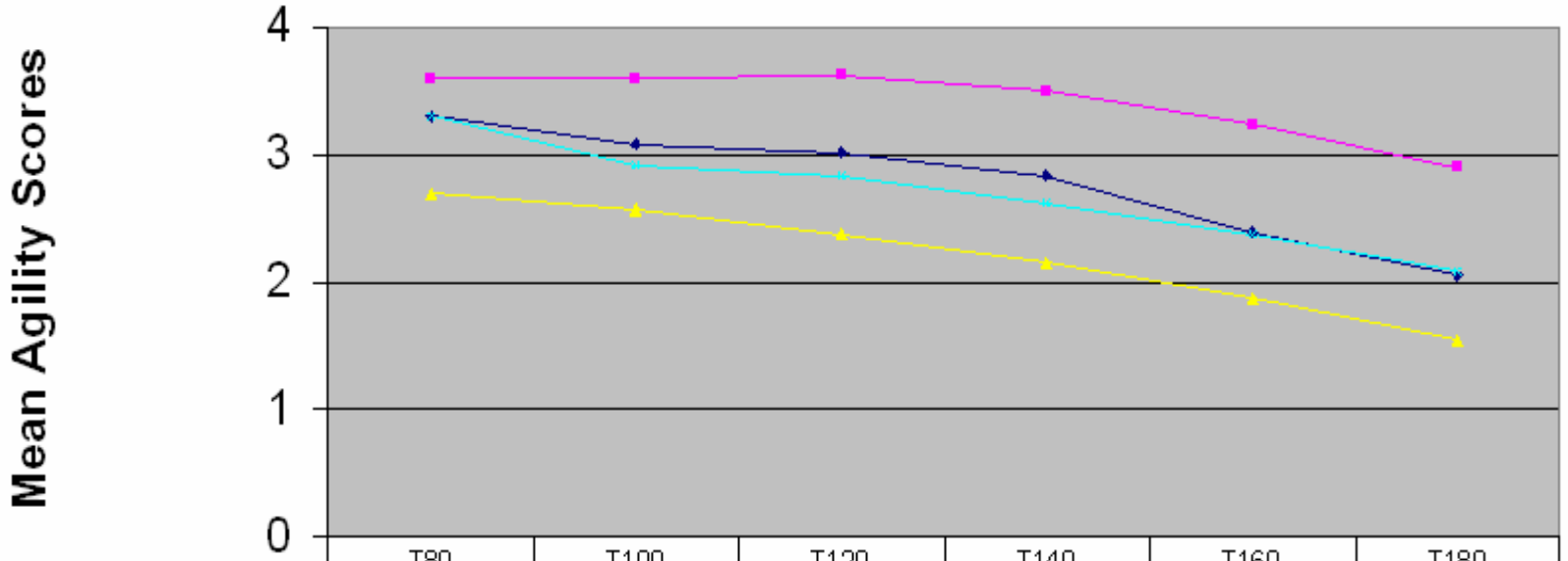
In the WithL group, standard deviations ranged from 0.75 in the cambiata category T180 to 1.21 in the baritone category T80. In the WithoutL group, standard deviations ranged from 0.82 (baritones) and 0.83 (cambiates) for T180 to 1.24 in the baritone category T80.

Mean agility scores in the WithL group range from a low of 2.06 in the cambiata category at T180, to highs of 3.60, 3.60, and 3.62 in the baritone category at T80, T100, and T120, respectively. The highest group scores belonged to participants in the later category of AVC, at the slower tempi.

In the WithoutL group, mean scores ranged from a low of 1.54 in the cambiata category T180, to a high of 3.31 in the baritone category T80. As for the WithoutL scores, the lowest group score belonged to participants in the earlier category of AVC, and the fastest tempo, and the highest group score belonged to participants in the later category of AVC, at the slowest tempo.

A three-way ANOVA with repeated-measures on two factors was used to compare mean scores by stage, lyric, and tempo conditions. Results indicated that there were significant differences attributable to the main effects of category F (1, 56) = 5.48, $p < .05$, lyrics F (1, 53) = 265.69, $p < .05$, and tempi F (5, 265) = 60.43, $p < .05$. While neither of the two-way interactions that included the Cooper category variable were significant $F_{lyrics\ by\ stage}$ (4, 53) = 1.43, $p > .05$; $F_{tempo\ by\ stage}$ (20, 265) = 0.95, $p > .05$, there were significant differences attributable to the other two-way interaction within this analysis $F_{lyrics\ by\ tempo}$ (5, 265) = 4.50, $p < .05$, and for the three-way lyrics by tempo by stage interaction $F_{lyrics\ by\ tempo\ by\ stage}$ (20, 265) = 1.83, $p < .05$. Thus for the Cooper categories, null hypotheses $H_{08,}$ $H_{09,}$ $H_{10,}$ $H_{11,}$ and H_{12} were rejected, but null hypotheses $H_{04,}$ and H_{05} were not rejected.

Figure 3: Graph of the Means of the Lyrics by Tempo by Cooper Category Interaction



	T80	T100	T120	T140	T160	T180
Camb.WithL	3.3	3.09	3.02	2.83	2.39	2.06
Bari.WithL	3.6	3.6	3.62	3.5	3.24	2.9
Camb.WithoutL	2.7	2.57	2.37	2.15	1.87	1.54
Bari.WithoutL	3.31	2.92	2.83	2.63	2.37	2.08

Table 9

Summary Table: Repeated Measure ANOVA Comparing Cooper Categories by Lyrics and Tempi

Source of Variance	SS	df	MS	F	p
Between Subjects					
Stage	54.30	1	54.30	5.48	.02*
Error	555.12	56	9.91		
Lyrics x Stage	1.42	4	.35	1.43	.24
Tempo x Stage	5.33	20	.27	.95	.52
Lyrics x Tempo x Stage	3.16	20	.16	1.83	.02
Error	22.89	265	.09		
Within Subjects					
Lyrics	65.79	1	65.79	265.69	.00*
Error	13.12	53	.25		
Tempo	84.48	5	16.90	60.43	.00*
Error	74.10	265	.28		
Lyrics x Tempo	1.94	5	.39	4.50	.00*
Error	22.89	265	.09		

*$p < .05$

Means and standard deviations contributing to the main effect for voice category are presented in Table 9. Results indicated that boys classified as baritones received significantly higher agility ratings than those classified as cambiates.

Means (with standard deviations in parentheses) contributing to the Cooper range categories of cambiates and baritones are 2.49 (SD = 0.92) and 3.71 (SD = 1.05) respectively. Average ratings were significantly higher for baritones.

Means and standard deviations contributing to the main effect for lyrics, tempi, and the lyrics by tempi interactions are the same as those for the Cooksey analysis, because the regrouping into Cooper categories did not affect these data. See Tables 5, 6, and 7 above for those data.

The data contributing to the three-way lyrics by tempo by category interaction were presented above in Table 9. Means were graphed to present a visual representation for further analysis (see Figure 3). While the graphs cross slightly for the Baritones WithoutL and the Cambiates WithL, which would account for the statistically significant interaction, the general patterns of scores which decline as tempi become faster, greater success for examples sung with lyrics, and higher scores for Baritones with lyrics are depicted clearly.

Agility and Choral Experience

Participants were asked to report the number of years of membership in a choral ensemble. Some reported membership for less than a year. For the purpose of analysis, each semester of study less than one year was designated in increments of .3 years. The relationship between years of choral experience and overall mean agility scores were compared using a Pearson Product-Moment correlation. Results indicated that this relationship was significant and positive, $r\ (57) = .38$, $p = .003$. Thus, H_{15} was rejected.

Summary

The results of analysis for both Cooksey stages and Cooper categories indicated that there were significant main effects for tempo, lyrics, tempo by lyrics interaction, and lyrics by tempo by stage interactions. While stage was not a significant factor in the Cooksey analysis, means for Cooper categories were significantly different. In general, higher agility scores were associated with slower tempi, and with sung lyrics. Participants in the later stages of AVC were judged to have better agility, as compared with the earlier stages, for both Cooksey and Cooper analyses, although differences were significant only for the Cooper categories, not the Cooksey stages. Results also indicated that number of years of choral experience was significantly related to vocal agility.

CHAPTER FIVE

Discussion

The purpose of this preliminary study was to more closely identify and measure one of the characteristics of voice change that has been discussed in the literature: the limitations of vocal agility during some stages of voice change. Teachers have been advised to avoid songs with fast-moving passages, and composers have been asked to keep this characteristic in mind when writing parts for boys of this age (Cooper, 1953; Cooksey 1997). Music educators disagree about whether a boy should sing or not sing during adolescent voice change (AVC), or sing primarily in his modal tessitura or falsetto. However, educators seem to have the same goals, to identify characteristics of the male AVC to make repertoire choices more appropriate, and to ensure that boys experience a healthy, meaningful singing experience that will ensure the healthiest singing quality in adulthood. Although many questions have been explored through excellent scientific research during the last century, many other questions about what is really happening during voice change remain unanswered. Each additional piece of knowledge puzzle has helped us discover more about what is normal, natural, and healthy during this key phase of a young male singer's life. American music educators have been particularly interested in removing any obstacles that may stand in the way of males' lifelong pursuit of the fine arts, and voice change has been one of those obstacles.

Participants in this study were boys in grades five through nine ($N = 58$). The sample was made up of volunteers who obtained parental permission to participate in the study. Gathering a large enough number of participants proved to be quite difficult, perhaps because singing alone might have been a fearful thing for many boys this age.

Obtaining willing participants from schools who had choir teachers committed to research was much easier than from schools where the researcher attempted to obtain participants on her own. I observed that boys were more likely to agree to participate if they trusted that I would not be critical about their singing, and if their choir teacher demonstrated support for me.

Early Observations

As the boys were recorded, some participants expressed an interest in how they were doing in comparison with other participants. The researcher attempted to praise each participant throughout the process without disclosing any information to the participant about how agilely he was singing in comparison with others. The seemingly natural tendency for the boys to compete with others in their age group was evident. I observed that some of the boys appeared to "get a second wind" or put forth more effort when they reached a tempo that sounded very fast to them. It was as if they heard the clicking of the metronome, judged that the tempo was faster than they might be able to perform easily, then they attempted to draw on more energy to complete the task. Some even smiled as they heard the faster levels, as if they thought the challenge was great, and they were going to enjoy that challenge.

Many boys who were asked to participate in this study refused. Of those who refused, some said that they could not sing, even though they were enrolled in music classes such as band, choir, or orchestra. Boys at the junior high age level have at times been teased by their peers for participating in music. I was careful to thank the participants for their cooperation and assured all who asked that their singing was normal

for boys their age. It was my goal to encourage and compliment the boys on their singing, and on their willingness to contribute to research in music education.

Stages/Categories

No statistically significant differences were found in agility scores among Cooksey stages. However, there was statistically significant difference found between the Cooper categories. This discrepancy may have been an artifact of the smaller groups created by division into five Cooksey stages as compared with the greater numbers per group for only two Cooper categories. No statistically significant interactions were found in any combinations of variables where stage was a factor.

The predicted outcome of the loss of agility in the baritone stages of voice change (Cooper, 1953) was not supported by the statistical analysis for this particular sample. I had expected that pitch agility would decrease in Cooksey's stage four as described by Cooksey and Welch (1998). Cooksey and Welch tested London Oratory and Primary School boys each month for a period of one year, and compared results with other earlier Cooksey studies in America. Their summary of agility for stage four AVC boys stated, "There tends to be even less pitch agility (compared to the midvoice stages)…" (p. 107). The same result was not found in this study, with the trend for agility scores to be successively higher for each of the Cooksey stages, and the significantly better performance of the baritones as analyzed for the Cooper method.

Because the literature implied that boys reaching the later stages of voice change have more difficulty with agility (Cooksey, 1997; Cooper, 1953; Groom, 1979), I was surprised to find in this study that the baritones were judged to sing with greater agility than boys in the earlier stages. Cooksey (1977) reported that agility in Stage four was

limited in intervals of fourths and fifths, and later wrote, "Newvoices and Emerging adult voices [stages four and five] tend to experience some reduction of flexibility and agility" (2000, p.830). However, agility was not tested in only stepwise melismatic passages in earlier studies, and the wider intervals used may account for differences among the results. In Ekstrom's (1959) study, the boys were instructed to sing "ah" in a one-octave arpeggiated pattern (do, mi, sol, mi, do), then a stepwise pattern, followed by the song "America." Groom (1979) used three recognizable melodies, "Gaudeamus Igitur," "Alleluia, Amen," and "God Bless America," containing melodic intervals of seconds, thirds, fourths, fifths, and sixths. The results of this study suggest that boys do continue to improve in stepwise agility as they reach later stages of AVC.

Researchers could use these methods for measuring agility as they continue to determine what is normal for boys in all aspects of AVC. Continued research should bring suggestions about how vocal pedagogy could be used effectively in the classroom. Curricula may need alterations to reflect agility capabilities for AVC students in a school's choral repertoire. As advised by Cooksey and Welch (1998), "Adolescent male voices cannot experience success in singing activities if their changing vocal limitations are not taken into account" (p. 109).

After teaching many hundreds of junior high boys and girls throughout my teaching career, it is my speculation that boys reaching the baritone stages of AVC often have difficulty determining in which octave the desired pitch should be sung. Do educators misinterpret the baritones' hesitation and confusion in locating the correct octave as a lack of agility? In other words, perhaps as the AVC baritone has searched for

the correct pitch in the correct octave, he has given his teacher the impression that he cannot move his voice easily.

Lyrics

As text is connected so closely to vocal music, it seemed important to explore in this study. Based on the literature and my experience, I had predicted greater ease of singing a fast passage with lyrics rather than without lyrics within the Cooksey stage divisions, and again in the Cooper category divisions. In conversation with adult singers, they seem to have experienced the sensation of greater physical ease in singing quick passages with words as compared with the same quick passages without words. I wanted to find if this was evident in the AVC voice as well. I did not find previous studies comparing agility when lyrics are used as opposed to no lyrics. Therefore, it was important to set up a comparison not only for the information it provided here, but also as a basis for future inquiry.

Measurements in this study suggested that the addition of English language lyrics (or consonant and vowel combinations) made a statistically significant difference in the ability of boys to sing with more agility than when they were asked to sing the same repeating stepwise pattern on an "ah" vowel. It is not known whether language patterns other than English might have another effect. All of the participants in this study considered their first language to be English, although three of the participants spoke a second language fluently at home. It is possible that the consonant and vowel combinations of some languages are easier to sing quickly than other languages. Voice teachers have commonly agreed that in addition to the student's mother tongue, languages such as Latin and Italian should be the beginning languages for students in

private voice studios (Castonguary 2005; Heller 2005). The pure vowel sounds (without diphthongs) of these languages offer less mouth movement for the singer. Other languages such as English which have vowel and consonant combinations such as the "i" in "light" present difficulties. Also, young singers may proceed "too quickly to the consonant (for example, hold the "a" sound in "raining" instead of moving quickly to the "ng") or the second vowel sound of a diphthong." (Herman, 1988, p. 41) The lyrics in the vocalise chosen for this study contain no diphthongs, only "ah," "oh," "uh," "eh," and "i (short vowel sound)." As Shaw stated (cited in Blocker, 2004),

> To most of us it comes as a shock in conservatory diction class to discover that a one-syllable word such as 'strange' or 'strained' can have seven or more phonetic sounds: . . .(Obviously, if a composer in a pugnacious penury of prosody allows us but an eighth-note at a *vivace* tempo to encompass "strained," chorally we are looking at instant linguistic hernia.) (p. 100-101)

Further research is needed to determine the effect that vowels, consonants, and their combinations might have upon a singer's agility, especially within a composer's suggested tempo. If this is an obstacle for adult singers as Shaw implied, might it not be more so for the AVC singer?

Tempo

The concept of tempo was tested in this study because tempo (musical rate of speed) is integral to music. Choral singers are expected to sing with accurate intonation within a great variety of tempi. This is a daunting task. As Shaw (Blocker, 2004) observed:

> Not infrequently—as in some of the faster choruses of a *B Minor Mass* or a *Messiah*—we take upon ourselves the task of lining up four-parts, each with six different pitches per second. . . .
>
> Our premise and intention can be realized only under two conditions—both of them extremely difficult to achieve:

> First, every participant must be excruciatingly sensitive to *tempo*—the passing of consecutive and equal units of (artificial) *time*; and absolutely nothing must be allowed to change that *tempo* which is not conscious and proportioned.
>
> Second, everyone involved must carry in consciousness at all times not only the larger unit of *tempo* (which we call *pulse*) but also its divisions and sub-divisions from halves and thirds to minuscule sixths and eighths.
>
> This is a simultaneity considerably more difficult to achieve for a chorus than for an orchestra. It is not only that ten fingers can respond faster than two vocal cords. It is that any language and all the sounds of speech have inherent durations and rhythms which may not necessarily be (indeed, almost never are) identical with their musical allotments. (p. 53-54)

Shaw conducted adult choirs. How much more daunting must this tempo element be for the boy singer struggling with dramatic voice changes? The research questions presented in this study were intended to find out what is normal and natural in the realm of agility during male AVC. Tempo had to be a guiding factor in this quest. I wanted to know what increasing tempo might do to the agility level within the same exercise.

Measurements were taken and analyzed to help discover just how fast and how easily one sample of AVC boys could sing stepwise syllabic and melismatic exercises.

I anticipated superior agility while the boys were singing at a slower tempo versus increasingly faster tempi, and this was supported by the statistical analysis. Not surprisingly, the element of increasing tempo had a profound effect on the agility capabilities of the boys in this study. As the tempo increased, agility decreased, as tested in increments of 20 beats per minute, from 80 to 180 beats per minute for each dotted quarter note. This result implies that choral music teachers should carefully monitor the tempo when working with AVC singers. Better intonation and vocal precision may be achieved when the tempo is kept within moderate limits.

Choral Experience

The correlation between choral experience and agility scores was statistically significant. Only two of the fifty-eight participants had not sung in a choir. Perhaps it is not surprising that these two students had low mean scores for all tempi of 2.17 and 1.00 with lyrics, and 1.42 and 0.92 without lyrics. It is possible that more experience in choir may lead to improved vocal agility. Further study should be done in this area. Implications for choral directors are that students with less choral experience could benefit from additional choral training to keep up with their more experienced peers. As Ekstrom (1959) also found that agility improved as singers were involved in choir for a longer time period, it would be interesting to know if some pedagogical methods are better than others. Are current agility exercises effective? Should agility exercises be taught in a particular sequence, such as stepwise, then thirds, then fourths, etc.? Should teachers explain the difference between moving the voice with the aid of consonants versus a legato vowel?

Additional Observations: Lessons, Intonation, Registers

The data gathering and judging procedures presented the opportunity for me to make informal observations. In completing the participant questionnaire, the participants were asked whether or not they had taken private voice lessons. The total number of boys who said they had taken voice lessons was seven (12%). These boys received a mean agility score of 3.36. The mean for the remaining 51 participants (reporting no voice lessons) was 2.72. Five of these seven boys who reported they had taken voice lessons were in Cooksey stages four and five (generally the higher means were in these stages). In spite of the fact that the comparison appears to indicate that vocal agility

could be at a higher level in boys who have had voice lessons, there were too few participants in the lesser group for a valid statistical analysis. A possible correlation between voice lessons and vocal agility deserves further study, perhaps related to the amount of time it may take for mastering agility. Pedagogical methods in the private voice studio could also be analyzed for effectiveness.

I observed other interesting aspects of the boys' responses throughout this study. As the data collection was conducted, and the boys were asked to sing the vocalise, the starting pitch was given as the median pitch in the Cooksey stage range chart. When the starting pitch was given for each tempo, 49 out of 58 boys (84.5%) tended to drift downward in pitch to a lower tonal center during the testing. Only one boy (1.7%) drifted slightly above and below the tonal center at different times. Eight boys stayed with the given tonal center throughout the test (13.8%). The tendency for AVC males to drift downward to the lower part of the modal range was also found in the agility research of Groom (1979). The assumption has been that the boys at this stage of vocal development tend to want to sing in the lower part of their ranges because it may feel more comfortable or that they feel they have more control (Cooper, 1953). However, in this study, if the participants drifted to another tonal center, the judges were instructed to rate the singers on their ability to sing intervals in tune with each other, rather than rating the accuracy of pitches within the given tonal center. In other words, the pitches had to have intervallic accuracy rather than all correct pitches in the given key. It was the intent of the researcher to only test for agility level, not precise intonation.

As the study moved from the recording of boys' voices to the judging of agility, I observed a number of additional interesting phenomena. The first was the variability of

participants in completing this task with intonational accuracy. The ability to successfully achieve excellent intonation is a relatively complex one involving a number of technical strategies (vowel formation, sub-glottal pressure, audiation, and so forth). Based on the participants' establishment of tonal center and corrective tuning capability, I rated them as either *certain*, *modulating*, or *uncertain* singers as I listened to the recordings with the judges. The terms *certain*, *modulating*, or *uncertain* singers have been used by researchers in exploring pitch-matching capabilities of children and adults (Price, 2000; Yarbrough, Jones, & Moore, 1994; Yarbrough, Bowers, & Benson, 1992; Price). Out of all the participants, 50% were noted as "certain singers," 39.7% were noted as "modulating singers," and 10.3% were noted as "uncertain singers." For a breakdown of the certain, modulating, and uncertain singers within Cooksey ranges and Cooper stages, see appendix F. Other research using different terminology for measuring the singing development of children has been undertaken (Phillips, 1996; Rutkowski, 1990; Welch 1986, 2000). Because singers' pitch-matching capabilities are one of the greatest challenges for junior high choral teachers, much more research is still needed in this area for the AVC singer. Specifically, the search for strategies that work well could save many boy singers who might currently be discouraged from singing. The Cooksey stage five singers who tend to sing entirely in the lowest notes of their ranges have been a particular challenge during my teaching experience. Teachers need a better workable method for helping AVC boys match pitch.

The use of primarily the modal or falsetto registers as demonstrated by these participants was also of some interest to me. A great amount of research has been done by researchers in the phenomenon of vocal registers (Philips & Emge, 1994; Thurman,

Welch, Theimer, Grefsheim, & Feit, 2000; Welch, Sergeant, & McCurtain, 1988). During this study as I listened to the recordings many times while randomizing and re-recording them, I noticed some peculiarities in register changes among the boys. Of all participants, a large majority (94.8%) sang in their modal register. Only three participants sang in their falsetto registers: two using a mixture of falsetto and modal registers, and one singing entirely in his falsetto register. Of the two participants using a falsetto/modal mixture, one was designated as Cooksey stage three, and the other was in stage four. The one participant who sang entirely in falsetto was designated as Cooksey stage three. This falsetto singer would hum his starting pitch in modal register, and then continue to sing the vocalise in his falsetto register. Perhaps this participant had choral training that resulted in his singing in the same octave with the rest of a group of unchanged males and females singers. Some choral educators insist that boys should sing in their falsetto registers a great amount of the time (Leck, 2001). Register changes and their resulting struggles for AVC singers need to be understood more fully by educators. Additional research leading to pedagogical methods concerning registers would be welcomed by choral educators.

Participant Strategies

I made another observation during the agility judging, concerning strategies boys used as they tried to keep up with the increase in tempo: (a) sliding the pitches together (22 boys); (b) moving the pitches closer to each other, thereby not completely reaching the perfect fourth interval of the melismatic pitch range (16 boys); (c) adding a consonant such as "h" before the vowel when singing the "ah" portion of the test (8 boys). Adding an "h" sound before the vowel may have been taught to the boys at some time, and

perhaps they were unable to distinguish the difference between this effort and a more legato sound. Even though their training session prior to the recording included an example of a legato "ahhh" for the WithoutL portion, and they were all given opportunity for practice, these eight singers still used the "h" sound compensation at some time during their recording; (d) leaving out some pitches (4 boys); (e) combinations of sliding pitches together and moving these pitches closer together than a perfect fourth (3 boys); and (f) combinations of leaving out pitches part of the time and adding consonants before the vowel part of the time (2 boys). The remaining three boys had no perceptible strategy.

Implications for Music Education

The issue of vocal agility is key to the overall issue of intonation in the vocal solo, small ensemble, and choral realms. If singers are unable to successfully navigate from one pitch to the next within a given tempo, then intonation suffers. Who wants to listen to a choir that cannot sing in tune? Who wants to be in a choir that cannot sing in tune? Educators continue to work to solve the problem of moving the voice cleanly from one pitch to the next in a variety of ways. Many include agility exercises in warm-up and technique building sessions at the beginning or during rehearsals. Exercises that begin at a slower tempo and increase to a faster tempo are often employed in an attempt to exercise the voice in such a way that the musculature of the larynx may become more responsive. On the other hand, other conductors and voice teachers advise that too much effort on the part of the singer to make his voice move more quickly will have the opposite effect, and actually impede his progress. As Indik (2002) secondarily titled,

". . . I could control myself if I could only let go so I could control myself." The effort to control can sometimes hamper success.

There is much to learn yet about how the voice works and how it responds to brain signals. In the meantime, some choral conductors try to solve the problem of the singing of melismatic passages at a desired tempo by dividing a section into smaller groups, asking some singers to sing every other pattern while another group sings the alternate pattern thereby creating an effect for the audience that the entire choir could achieve the agility required. A second attempt is to ask a few singers in each section of the choir to place a consonant such as "t" or "d" before the vowel on every pitch during the quick passage. As the entire choir sings, these few "cheaters" are not noticed, but the whole effect for the audience is one of cleaner agility. A third attempt on the part of conductors to improve agility is to ask the singers to concentrate on singing the lesser rhythmically stressed pitches within a melismatic pattern with more stress. For example, in a commonly seen melismatic pattern in Baroque music that contains four measures of sixteenth notes, the singer will think about singing the 2nd and 4th sixteenth notes in each pattern of sixteenth notes with more stress than the more natural stress of the 1st and 3rd sixteenth notes of each beat. This effort is made to even out the pitches and bring more fluidity to the phrase, but also requiring a high level of vocal agility on the part of the singer. A fourth commonly used strategy to bring cleaner intonation to the melismatic passage is the ask the singers to begin singing the passage by inserting a consonant at the beginning of each note sung, then as the singers have practiced for some time in this manner, they are asked to drop the temporarily added consonant and sing only on the vowel.

All of these strategies attest to the fact that singing with agility is one measure of virtuosity. The ability to sing by moving the voice quickly in an unencumbered manner is valued in many cultures. The ornamentation to a melody within earlier European compositions, and the improvisational addition to the melody commonly practiced by American gospel and pop music singers are examples of the value placed on the ability to move the voice quickly. Therefore, the responsibility held by educators to teach others how to achieve this agility is only one of the many tasks needed to help each of their students reach his potential.

A method of assessing agility has been introduced here that could be useful in several ways. The instruments (vocalise, recording method, judge's rubric) might be used by teachers of AVC boys to assess their agility skills. A choir conductor and/or a private teacher might use this method to measure agility and compare a boy's progress from the beginning of a year to the end.

Researchers could use these methods for measuring agility as they continue to determine what is normal for boys in all aspects of AVC. Continued research should bring suggestions about how vocal pedagogy could be used effectively in the classroom. Curricula may need alterations to reflect agility capabilities for AVC students in a school's choral repertoire. As advised by Cooksey and Welch, "Adolescent male voices cannot experience success in singing activities if their changing vocal limitations are not taken into account" (p. 109).

The topic of agility in the total choral experience is one small part of the child's musical expression. Questions remain: Can singers of a certain age learn to sing with better agility, or does the biological growth of the larynx impede this process during

particular stages of growth? Do exercises to increase vocal agility really work with this age group, or are singers and educators wasting their time? Should choral directors assign music with quick tempi and melismatic passages to boys of certain stages of development, or are they setting them up to fail? Should directors and music festival adjudicators consider the agility factor when assessing choral success?

This preliminary study looked at groups of boys in certain stages of voice change. However, the individual variance from one boy to another can be very great. Educators must continue to be aware of the individuality of singing voices and avoid categorizing students into impersonal stages or groups. Experienced music teachers of young adolescent and pubescent boys understand that emotional factors arise during this time of their maturation (Cooper & Kuersteiner, 1965; Harrison, 1978; Roe, 1994; Gerber, 1994). If singers are made to feel inadequate about certain aspects of choral singing such as intonation, range limitations or agility, they often cease to continue trying. As music educators become better informed about the voice change process, patience with singers under their tutelage may increase. When choral conductors understand that limitations during AVC are only temporary and discover information about voice change indicating that more and more practice leads to better results, then they may become better cheerleaders for the students and encourage them to keep trying. The greatest gift that a teacher gives her student is confidence in that student's ability to learn. The confidence factor for singers is a very big key to overcoming problems with the vocal instrument. This confidence factor can be intensified in students of this emotionally charged age group. Therefore, the music educator must continue to assess each student's agility level

on the basis of his personal best, and encourage him to enjoy finding the meaning of music in his own life.

Suggestions for Future Research

This study was limited to a specific group of participants. The agility issue should be researched in a number of additional ways. This study should be replicated with a larger sample size to explore whether these results can be generalized to a larger population. Longitudinal studies of AVC have been done by Cooksey (1980) in California ($N = 90$), and with boys enrolled in the London Oratory School, who were found to follow a similar sequence of voice change as found in Cooksey's earlier research (Cooksey & Welch, 1997). Longitudinal research with typical American adolescents would provide valuable information related to individual patterns of vocal development.

Diverse populations of AVC boys from various ethnic groups could be studied more fully. Hughes (1984), studied differences in the onset of voice change between African American and Caucasian boys in the southern United States, and found that African American students began the voice change process earlier. Buckton (1976) studied individual differences in vocal ranges of boys in New Zealand, and found that the music curriculum included many songs outside their ranges. Using the tenets of Cooper's cambiata concept, Spann (1968) compared voice change among Brazilian boys with boys in the United States, and discovered that Brazilian students could be categorized into the same two phases of change (cambiata and baritone) as American boys. Future research is needed to compare Latino, Native American, Asian American, and other cultures in America and around the world, to continue the educational effort of providing for individual differences among boy singers.

The issue of using lyrics as an articulator for agility should be studied using a variety of languages. Choral music around the world employs thousands of combinations of consonants and vowels in many languages that are integral parts of the total choral sound. Educators and researchers should continue to explore the part that lyrics in all languages may play as a component to a singer's agility level. Are some consonant and vowel combinations easier than others? Which ones? Because this sample of AVC students was rated by judges to have better agility when using lyrics than when the vowel "ahhh" was used, questions can be raised about whether or not perception of the singers was the same. Do singers perceive that it is easier for them to sing melismas with or without the use of lyric articulators?

Comparisons should also be made in agility levels between boys of voice change stages and unchanged voices. A test similar to the one in this study should be employed with unchanged voices to compare those younger voices with AVC boys. A sample of the population of adult male singers should also be compared with the agility level of AVC boys to discover similarities and differences.

Experimental research investigating various instructional methods for teaching agility would be valuable for all age groups to determine the extent to which agility is amenable to instruction or dependent on growth and development. Measuring agility using different intervals (e.g., major and minor thirds; perfect fourths; diminished, augmented, and perfect fifths) could answer questions about how boys of this age may be able to handle moving from one note to the next in wider intervals. The implications toward repertoire selection and choral composition aimed at students in this age level remain tied to their singing abilities. Vocal agility is one important aspect to be

considered as teachers select appropriate repertoire, and as composers write for this population of singers.

This instrument could also be used to assess students in an experimental design: Students' agility may be measured using this method prior to working on a song with melismas. The teacher could then instruct the students with effective agility strategies while rehearsing the choral piece. Another agility measurement would be made once again after the song is performed to assess student progress.

A few of the boys in this study sang with vibrato some of the time. Is there a relationship between the employment of vibrato and vocal agility? The use of vibrato at varying speeds should be investigated to discover any possible effect on vocal agility.

Research with the male changing voice should also be continued in areas of dynamic flexibility and tone quality. Cooksey (1977, 2000) has continued to champion the cause of understanding the unique qualities of boys experiencing AVC. Pedagogical methods should continue to be tested using observed and measured limitations in vocal flexibility.

Questions about the use of the falsetto voice in this age group also remain. Is prolonged use of the falsetto register damaging or beneficial? Empirical evidence is needed to support the advice of educators who advocate falsetto singing for adolescents (Leck, 2001).

Agility differences may also exist in different registers (modal, falsetto) of a boy's total singing range, and in the high and low extremes of modal range. Studies are needed to compare agility in lower versus higher singing ranges for boys of changing voice, and for singers in all age groups.

The issue of private voice training for AVC boys remains undecided. Is it beneficial for boys to take private voice lessons? Can private voice training bolster the psychological confidence level and/or agility level in the adolescent singer? Experimental studies of voice training methods such as the Smolover vocal behavior training (Chapman, 1989) or the Alexander technique (Pryor, 2000) could enhance our knowledge about pedagogical methods. In spite of the great amount of research that has been done on the fascinating topic of the male changing voice, there is still so much to be learned.

The sample of boys in this study were volunteer participants who were not afraid to sing alone and participate in a research study. Thus, generalization of the results to the entire population of male changing voice adolescents may not be appropriate. Although the findings have implications for boys who are comfortable singing, the extent to which these findings might apply to boys who have not been singing is not known.

Summary

The purpose of this study was to explore only one aspect of the often mysterious changing voice: agility. I hope that teachers can use this information to better serve the needs of their singers. Educators who have successfully worked with young people in the pubescent/adolescent stage of life know what others may not--that there is incredible musical potential in students of this age. This musical ability is often overlooked by some who would rather not deal with the peculiar challenges of this group, hoping that they will somehow get through this stage to an advanced level on their own. Some of these challenges of the male adolescent voice change have been explored in this study. One specific aspect, agility, has been measured and analyzed. Based on the assessment

of agility in this sample of the AVC male population in the Midwestern United States, results indicate that in sung step-wise melismatic patterns:

6. Boys in progressively later stages of voice change were judged to be increasingly more agile, on average. Differences among stages were statistically significant for Cooper's range categories, but not for Cooksey's five stages of voice change.
7. Agility was more accurate when lyrics were employed, than when "ahhh" was used to sing the exercises.
8. Agility decreased as tempo increased.
9. Agility correlated positively with years of choral experience.

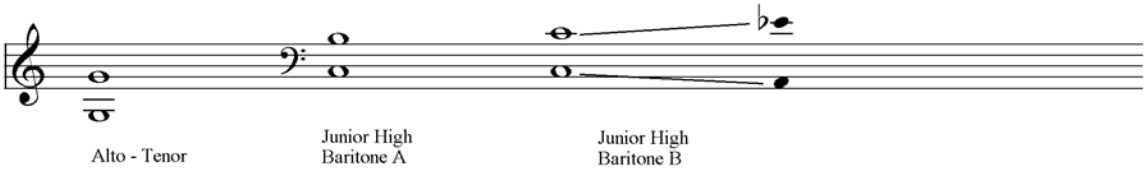
Closing

Because the agility issue has been raised by researchers such as Cooper (1953), Ekstrom (1959), Groom (1979), Cooksey (1977, 1997), and applied to the male changing voice, it is hoped that the information in this document is useful in the quest for more answers to the beautiful and unique male changing voice. This very fragile time in a young man's life as he completes the rite of passage from childhood to adulthood holds obstacles to his future musical involvement. Many boys have given up the singing that they loved as children because the changes they experience in pubescence and early adolescence convince them that they are no longer capable of singing well. Reliable information is needed to help music educators and their students make informed decisions about what boys of this age group might expect as normal singing. Concert halls, community choirs, universities, and secondary schools around this nation and the world need singers who have been given the best possible chance to reach their potential.

Appendix A

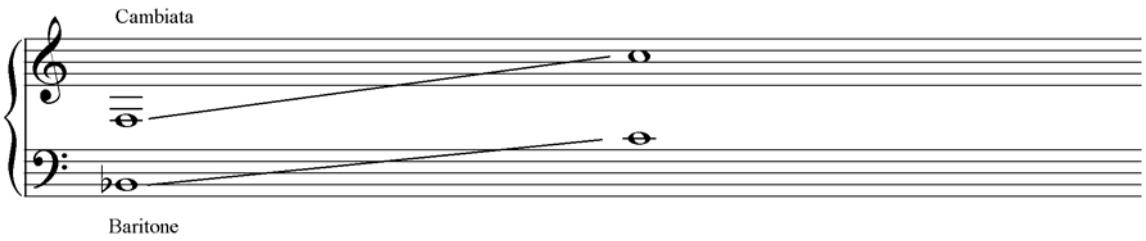
Range Charts

McKenzie Male Changing Voice Ranges*



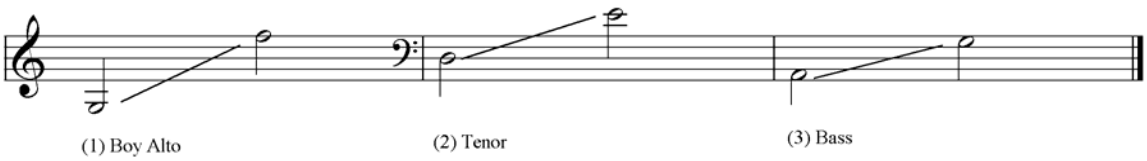
* McKenzie, D. (1956). *Training the boy's changing voice.* New Brunswick, NJ: Rutgers University Press.

Cooper Male Changing Voice Ranges*



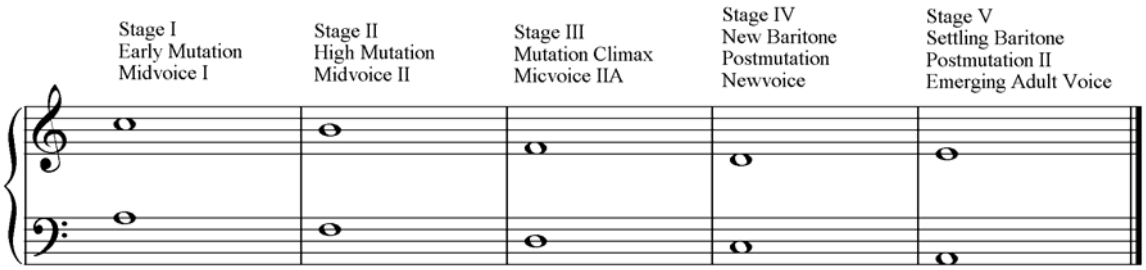
* Cooper, I. (1950). The junior high school choral problem, *Music Educators Journal,* 37(2), 10,21.

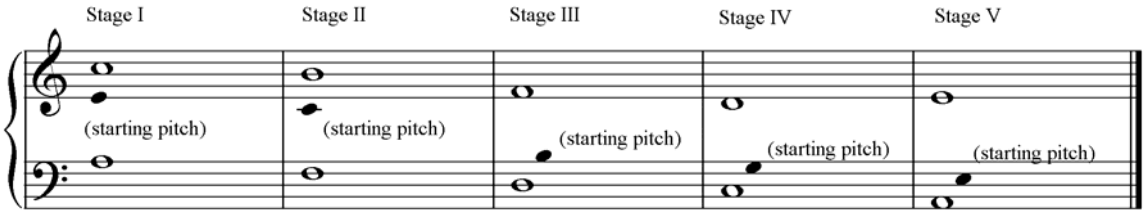
Swanson Male Changing Voice Ranges*



* Swanson, J.F. (1961). The proper care and feeding of changing voices, *Music Educators Journal,* 48(2), 63-64,66.

Cooksey Male Changing Voice Ranges*





Starting pitches noted above were used as beginning pitches for the vocalises. See Appendix D for the entire vocalise in each Cooksey stage.

* Cooksey, J.M. (2000). Male adolescent transforming voices: voice classification, voice skill development, and music literature selection, In Thurman, L. & Welch, G. (Ed.), *Bodymind & Voice: foundations of voice education, book five: a brief menu of practical voice education methods.* Collegeville, MN: Voicecare Network.

Appendix B

Letters of Informed Consent

Sally Hook
Music Specialist, Columbia Public Schools
West Junior High School
Columbia, MO 65203

December 12, 2004

Dear Parents/Guardians,

My name is Sally Hook, and I have been a vocal music teacher at West Junior High School in Columbia, MO, for sixteen years, working with boy singers as their voices change. As a doctoral student at the University of Missouri, I am conducting research on male singing. Because boys during grades five through nine are usually experiencing a voice change that affects their singing, I am measuring the speed or tempo with which the average male can sing during this time. I need volunteers to sing an easy vocal pattern at differing tempi. The pattern will be taught to them prior to measuring their singing speed. This research may help music teachers as they select appropriate music for students in choirs or as soloists.

Student volunteers will sing for the researcher during two sessions, each lasting approximately five to eight minutes. One session will be to determine in what stage of voice change the student may be. The second session will be to tape-record the student singing the pattern at differing speeds**.** Your child will be free to stop at any time without penalty. All information will be kept anonymous by assigning numbers for student participants. If you would like to be in the room when your son sings for me, please indicate that on the attached consent form.

The research project is #1045277 with the University of Missouri-Columbia IRB (Institutional Review Board). The phone number for the IRB office is (573) 882-9585 or you may reach them at this e-mail address, umcresearchcirb@missouri.edu. My advisor for this project is Dr. Wendy Sims. You may contact her by e-mail at simsw@missouri.edu or by phone, (573) 884-0002. Please feel free to contact me, as well, if you have any questions regarding this study by phone at (573) 214-3005, or my e-mail address: shook@columbia.k12.mo.us.

Following the data gathering process, you will receive a notice of the research results. Thank you for agreeing to allow your student to participate in this descriptive research project by signing and returning this letter via your student to your child's teacher.

Sincerely,

Sally Hook

Parent/Guardian Consent form:

_____ (print student name) has my permission to participate

in the above described research. _____ (parent/guardian signature)

My student's school is (print)_____

My child's birth date is (MMDDYYYY) _____

My phone number is _____My e-mail address is _____

Today's date _____

I would like to be in the room when my son sings for you. ___ Yes ___ No
If you answered "yes," would you prefer to be contacted via ___ Phone ___ E-mail

Student Consent form:

In this study I will sing a simple melody at varying speeds from the highest to lowest pitches that my voice allows. In two sessions of 5-8 minutes each, my voice will be tape-recorded for research purposes. My name will not be used in the study, as a number will be assigned to my singing. No additional persons other than the researcher (and a parent if requested) will be in the room as I sing.

If I do not wish to be in this study or I decide that I do not want to continue after I begin, I may stop and tell the researcher. I may then be removed from the study with no penalty. The research will not affect my grade at school in any way. No one other than the researcher will know that I stopped.

If I have other questions, I will call or e-mail the researcher.

Name (print) _____

Signature _____ Date _____

Appendix C

Student Questionnaire

Student Questionnaire

Today's Date_____

☐ Anonymous Research Number

Research in Measuring Vocal Agility during Vocal Maturation
Student Questionnaire

Please answer the following questions as honestly as possible. Your name will not be used in this research.

1. When were you born (MMDDYY)? ☐☐☐☐☐☐
2. What is your first language (English, Spanish, etc.)? _____
3. Have you ever taken private voice lessons? yes☐ no☐
4. What school do you attend? _____
5. What grade level in school are you? five☐ six☐ seven☐ eight☐ nine☐
6. Have you ever sung in a choir? yes☐ no☐
   If yes, how many total months/years have you sung in choirs? 1-4 months☐
   5-8 months☐ 9-12 months☐ 1 year☐
   2 years☐ 3 years☐ 4 years☐ 5 years☐ more than 5 years☐
7. Are you familiar with the tune "Follow the Yellow Brick Road" from the movie *The Wizard of Oz?* yes☐ no☐

Placement in one of five stages of vocal maturation (3-5 minutes):

Please follow the directions of the researcher as you sing some patterns with the aid of a piano. The researcher will place you into one of five stages of voice range that you match right now. All voice range stages are normal for boys. Whatever you sing will be correct for you.

To be checked by the researcher:

☐ Unchanged

☐ Stage I ☐ Stage II ☐ Stage III ☐ Stage IV ☐ Stage V

☐ Beyond Stage V

Address where research results can be mailed:

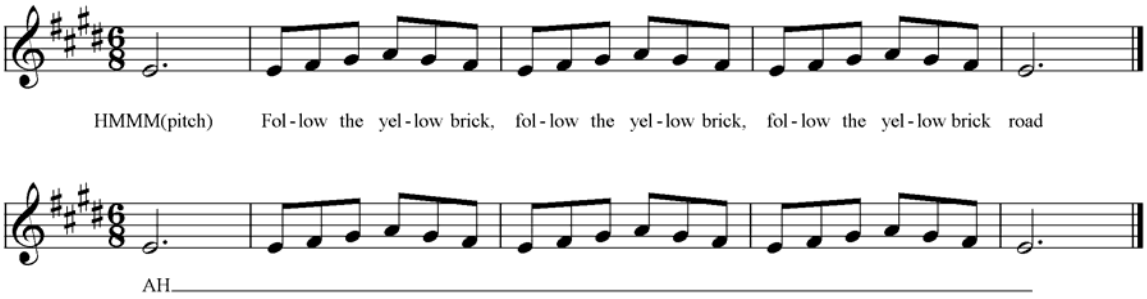
_____

_____

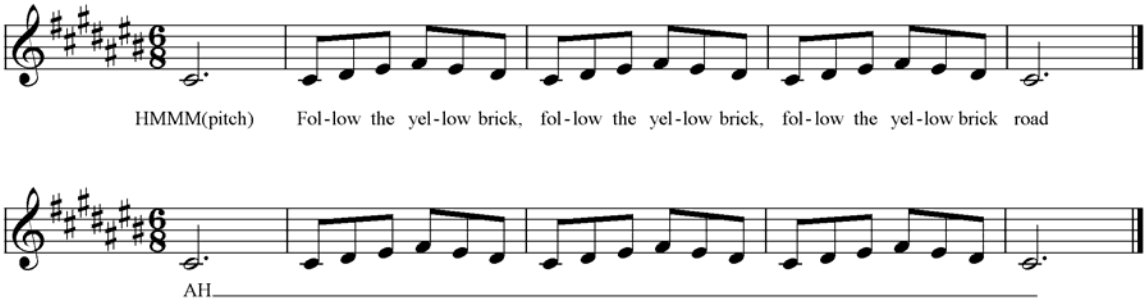
Appendix D

Vocalise

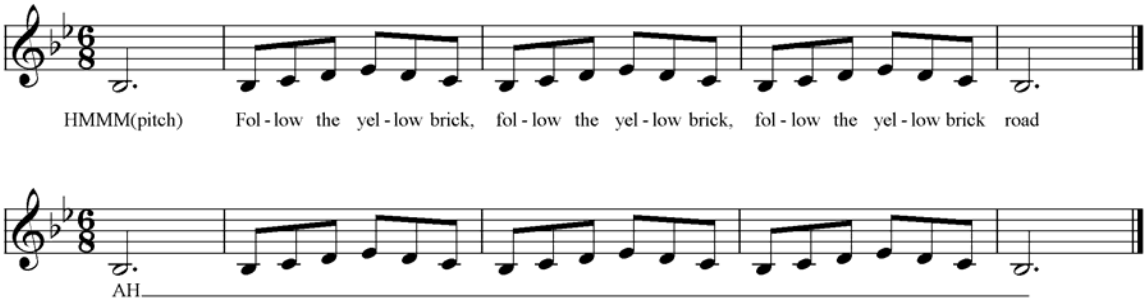
VOCALISE COOKSEY STAGE ONE



VOCALISE COOKSEY STAGE TWO

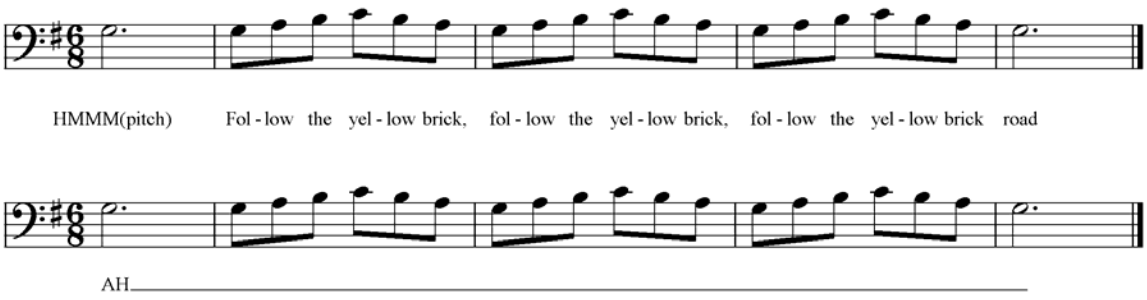


VOCALISE COOKSEY STAGE THREE

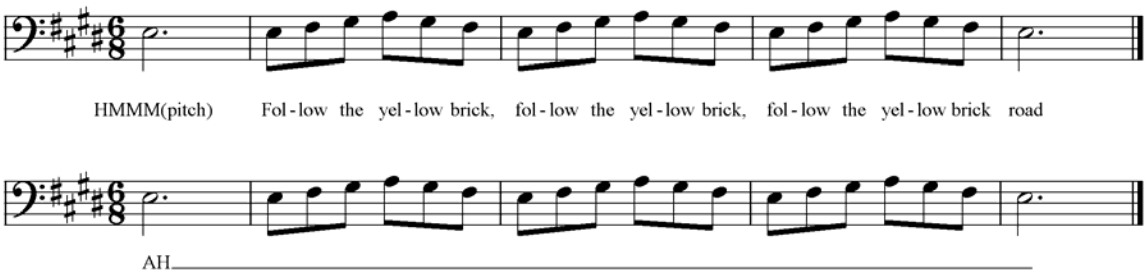


Appendix D, continued

VOCALISE COOKSEY STAGE FOUR



VOCALISE COOKSEY STAGE FIVE



Appendix E

Randomized Order of Participants With Stage/Category, Age, and Agility Means

Randomized Order of Participants
With Age, Stages, and Mean Scores

Order of Adjudication	Anonymous Research number	Age in months	Cooksey Range stage	Cooper Category (cambiate baritone)	With Lyrics Mean score	Without Lyrics Mean score
1	820	174.70	2	C	4.08	3.42
2	915	182.07	5	B	4.75	4.08
3	714	162.17	1	C	3.08	2.08
4	828	165.10	2	C	3.17	2.50
5	903	178.63	4	B	3.17	2.08
6	807	174.80	5	B	3.83	2.92
7	812	170.47	4	B	2.50	1.83
8	907	176.87	4	B	4.39	3.75
9	814	171.73	2	C	2.00	1.25
10	905	178.50	5	B	3.83	3.50
11	802	178.13	4	B	1.67	1.08
12	502	137.63	1	C	2.75	1.92
13	710	156.07	1	C	1.92	1.83
14	913	179.93	3	C	3.50	3.33
15	826	176.90	4	B	3.83	3.42
16	815	170.53	3	C	4.33	3.58
17	608	144.63	1	C	2.67	1.42
18	822	177.30	5	B	4.00	3.17
19	917	183.03	4	B	3.00	2.25
20	801	175.50	2	C	1.58	1.33
21	603	150.27	1	C	3.67	3.00
22	709	166.00	3	C	2.17	2.33
23	806	175.53	5	B	2.75	2.50
24	708	166.67	2	C	2.75	2.17
25	911	187.50	4	B	4.58	4.05
26	813	166.93	5	B	2.00	1.50
27	809	168.63	4	B	4.08	2.75
28	706	156.73	2	C	2.50	1.58
29	808	173.63	5	B	4.58	4.30

(continued next page)

Appendix E, continued

Randomized Order of Participants
With Age, Stages, and Mean Scores

Order of Adjudication	Anonymous Research number	Age in months	Cooksey Range stage	Cooper Category (cambiate baritone)	With Lyrics Mean score	Without Lyrics Mean score
30	609	147.23	1	C	1.42	0.17
31	910	183.57	4	B	3.08	2.25
32	816	174.67	5	B	3.17	2.00
33	705	160.63	2	C	2.83	1.67
34	912	185.20	5	B	4.08	3.67
35	825	165.23	4	B	2.00	1.17
36	914	190.50	4	B	4.58	3.80
37	713	158.43	1	C	2.92	2.42
38	810	176.03	4	B	2.42	1.92
39	906	178.50	5	B	3.83	2.75
40	823	170.73	2	C	3.92	3.33
41	711	162.23	2	C	1.67	1.33
42	817	172.80	3	C	1.42	1.00
43	909	187.13	4	B	3.92	3.25
44	601	141.03	1	C	2.75	2.50
45	916	184.27	5	B	4.08	3.67
46	703	159.97	3	C	2.42	2.25
47	804	176.27	5	B	1.00	0.92
48	704	159.83	3	C	3.25	2.50
49	821	167.90	4	B	2.08	1.17
50	811	166.90	3	C	3.17	2.67
51	908	188.27	5	B	4.42	3.58
52	805	172.40	2	C	3.08	2.75
53	919	187.30	5	B	2.67	2.00
54	819	163.10	5	B	4.67	3.17
55	701	153.93	2	C	4.17	3.17
56	602	150.53	4	B	3.00	2.00
57	920	190.43	4	B	4.25	3.33
58	904	181.27	2	C	1.92	1.92

Appendix F

Table of Certain, Modulating, Uncertain Singers

Numbers of Singers Identified in Cooksey Stages as Certain, Modulating, Uncertain

	Certain	Modulating	Uncertain
Stage 1	4	3	1
Stage 2	4	8	0
Stage 3	3	3	1
Stage 4	8	6	2
Stage 5	10	3	2
Total	29	23	6

When this information was applied to the Cooper categories, the following results emerged

Numbers of Singers Identified in Cooper Categories as Certain, Modulating, Uncertain

	Certain	Modulating	Uncertain
Cambiates	11	14	2
Baritones	18	9	4
Total	29	23	6

Appendix G

Agility Adjudication Form

Agility Adjudication Form

Mark numbers on the following rating scales which correspond with the level of agility (defined in the accompanying rubric) that you hear on the CD. As your standard, when marking "5," think of the best possible agility that you would like to hear in a choir of 10-15-year old students. When marking "0," think of no movement of the voice (agility) whatsoever. Please do not discuss your marks with other adjudicators in the room. If you have questions of the researcher, please ask them so that all adjudicators may hear equally. You may consult the attached rubric at any time.

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←Place a mark in the box at the left upon hearing the subject's number.

Tempo ↓	Rating ***with*** lyrics 0	1	2	3	4	5	Rating ***without*** lyrics 0	1	2	3	4	5
80												
100												
120												
140												
160												
180												

Would you describe the singer as …

Uncertain singer	Modulating singer	Certain singer

If the singer did not stay within the given tonal center, was he…?

Higher	lower

Did the singer sound like he was using falsetto?

Yes	no

When he sang **without lyrics**, was he using one of the following strategies?

Adding consonants before vowel sounds	Sliding pitches together	Leaving out pitches	Moving pitches closer together < P4

General Comments:_____

_____

_____

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